OUR DAILY WATER SUPPLY.

M16395

PRESENTED BY
EDGAR M. CROOKSHANK, Esq.
SENIOR VICE-PRESIDENT
OF THE COLLEGE.
1925

THIS BOOK
IS THE PROPERTY OF THE
ROYAL VETERINARY COLLEGE
CAMDEN TOWN

Our
Daily Water Supply.

BY

C. E. PARKER-RHODES,

Late of H.M. Consular Service;

Author of "WATER REFORM," *an Essay read at the Brighton Health Congress*, 1881; "SANITARY CONDITION OF THE PEOPLE," *an Essay read at the Social Science Congress*, 1875; "GREAT BRITAIN AND IRELAND IN 1886;"
&c., &c.

1887.

London:
E. W. ALLEN, 4, AVE MARIA LANE,
AND
THE SCIENTIFIC PUBLISHING COMPANY, LIMITED,
22, BUCKINGHAM STREET, STRAND, W.C.

M16395

WELLCOME INSTITUTE
LIBRARY

Coll.	welMOmec
Call	
No.	WA 675
	1887
	P24o

CONTENTS.

PART I.

PAGE

Bodily ailments frustrating life enjoyment 1

Filter-beds conducing to ill-health 2

Surface water unwholesome 3

Mineral waters injurious 3

Renewal of the human frame 4

Complaints of all classes of both sexes 4

Fretful infant 4

Hard Water—action on the body 5

„ baths, laundry, and house utensils cleaned with 11

„ in the preparation of food 12

„ for our beverages 12

„ for laundry work 13

„ for textile manufactures 14

„ the infant's and the child's ablutions in... 14

„ on the skin 15

„ conduces to blood poisoning 16

„ soap used in common for linen 17

„ cause of epidemics... 17

„ soap used in common for the body in ... 18

Royal Commissions... 24

Lords' Committees 24

House of Commons—Select Committees 24

"As to Hard Water" 24

Supply of the Metropolis with spring and deep well water 28

The softening of water by lime 28

Professor Clark's process adopted 29, 40

Softening of hard water 33

CONTENTS.

PAGE
Water supplied by the Metropolitan Water Companies 36
Effect of hard water in boilers 37
Brighton Health Congress, 1881—W. H. Hallett, Esq. (Mayor) 38
"Morning Post" Soft water wanted—C. R. Drysdale, Esq., M.D. 39
Soft water has no action on leaden pipes 39

PART II.

Impure water 42
Fifteenth Report of the Local Government Board *(Supplement)* 43
Sixth Report of the Royal Commission 55
"Impure water" 57
Water supplied to London from the Thames 59
City of London—W. Sedgwick Saunders, Esq., M.D. .. 60
Water supplied to London from the Lea... 63
Water supplies of other British Cities, &c. 64
Possibility of rendering polluted water again wholesome 65
Propagation of epidemic diseases by potable water ... 66

Brighton Health Congress, 1881—

The seed time of health—B. W. Richardson, Esq., M.D. 67
Address—Edwin Chadwick, Esq., C.B. 67
„ Alfred Carpenter, Esq., M.D. 68
Hints on domestic sanitation—Henry F. Strong, Esq., M.D. 70
Propagation of disease through food and drink—R. P. Taaffe, Esq., M.D., *Medical Officer of Health for Brighton* 72
Sermons—Rev. J. J. Hannah, *Vicar of St. Nicholas, Brighton* 74

Press— PAGE

" Daily News"—The Cholera 76
" Daily Chronicle"—15th Annual Report L. G. B. 77
" " Pollution of the River Lea... 78
" Morning Post"—Plague of Eels 78
" Echo"—Eels in the Pipes 79
" Daily Chronicle"—Eels in the Pipes *(Correspondence)*... 79
" Daily Telegraph"—Eels in London Water Mains *(Correspondence)* 80
" Daily Chronicle"—Eels in London Water Mains 82
" Daily Telegraph" " " " " 82
" Daily Chronicle"—Strange Phenomena *(Correspondence)* 83
" Daily Chronicle"—On Smells 83
" " " *(Correspondence)* ... 84
Water Companies and the Public—Report of Parliament 85
Water for Animals 86

PART III.

Conclusion—

Chemical Science—Engineering Science 87

Appendix—

Sir Robert Rawlinson, C.E., C.B., Local Government Board.

W. Whitaker, Esq., Geological Survey of England.

W. Farr, M.D.

Sir Frederick Bramwell, C.E.

E. Easton, Esq., C.E.

Earl Fortescue, President, British Association, 1877.

Digitized by the Internet Archive
in 2014

https://archive.org/details/b20405133

PREFACE.

Monopolies are unexceptionally anomolies, in every sense of the word, as regards the United Kingdom of Great Britain. Free Trade is claimed by its advocates to be essential to the expansion, extension, and continuous growth of our home and foreign trades. In a large measure they are supported by facts which are beyond controversy, and yet the results of *Free Trade*, as we have established it, are far from satisfactory, both to the individual and to the nation. In the days of stage-coaching, the conveyance of the Royal Mails constituted the enterprise a monopoly. Superiority of steam-power over the panting steed soon caused Railways to supersede stage-coaching, and to-day the "iron horse" puffs its way through hamlet and village, town and city; across streams, over hills, and below the surface of the dense traffic of the busy mart: a monopoly by Act of the people's Parliament.

The docks and mooring grounds for the safety of the shipping of all nations are a monopoly by Act of the people's Parliament.

Monopolies are granted to individuals daily, under Letters Patent, by Act of the people's Parliament. All Royal Licenses are monopolies to the exclusion of the masses, in the face of the people's Parliament. The advantages of gas light are obtainable only from the one company empowered to supply the public within the defined area—still a monopoly by Act of the people's Parliament. "Our daily water supply" is a monopoly under Acts of the people's Parliament.

These monopolies have their advantages and their disadvantages. On the one hand they confer a public good, and on the other hand they are unjust on the principle of Free Trade.

Looking at monopolies from every standpoint, with all their disadvantages and positive injustice in particular cases, they have been created for the purpose of doing, with combined action and capital, that that individual action and capital would be powerless to accomplish. Taking the monopoly of water supply, the risk of the venture is very great, and involves a considerable outlay before a compensating dividend could be ensured. This being admitted, it would, therefore, be unjust to deprive the Water Companies of their monopoly without an equitable price being agreed upon by the people's Parliament to annul the monopoly.

In the interest of the venture, doubtless, the executive of each Water Company exerts its utmost power to supply water of a character required by the Act of Parliament, and where failure occurs, either in quantity, or in quality, the fault may not be with the Water Company.

At the same time, when the standard of supply is not reached, as prescribed by the Act of Parliament, it becomes the duty of the people's Parliament to advise, adopt, and enact such measures as can at once remedy the injurious consequences of the monopoly. Unless the Water Company acts in direct contravention of the obligations set forth in the Act of the people's Parliament which granted the monopoly, it would not be an honest proceeding to deprive the Water Company of its privilege, and thus jeopardise the invested capital of its shareholders, sunk in the construction of reservoirs, filter-beds, machinery, mains, and other plant. Those who do not possess Water Company's stock, or scrip of any kind, should consider how jealous they would be of their rights and privileges were the monopoly in their hands.

Water consumers are heavily rated, far in excess of the value of the water supplied, the nett assessment, and particularly the gross assessment,* being a most unfair basis on which to establish the per-centage rate. Then, again, the demand for water rate, irrespective of the supply of water, or of the quality of the water, is not honest under the monopoly of the Act of the people's Parliament. The charge for high-pressure, although set forth in the respective Water Companies' Acts of the people's Parliament, is a legal sanction to the surreptitious increase of the ordinary service rate for each house, the w.c.† being forcibly above ten feet high from the main. The inequitableness of the water rate is most prominent in the case of two houses, the one of a larger rental having less inmates than the house of a lesser rental, according to which the gross and nett assessments are fixed, the per-centage being chargeable thereon.

The injustice of the Act of the people's Parliament that gives power to the Water Company to enforce payment of arrears from tenants entering into possession of tenements, dwellings or houses, and on refusal, to cut off the water supply, was confirmed by the House of Commons in 1885, although the House of Lords passed the Bill to remove such despotic and unjust powers from the Water Companies' Acts.

In respect of dwellings untenanted, to be liable for half-rate payable by the owner, the charge is most unfair, considering that no other enterprise is so privileged, not even "Consols," the State investments; when a heavy fall takes place the holders are not in any way recouped or compensated.

The Water Companies' Acts of the people's Parliament are *alone to blame for the injustice.* The directors are merely trustees for the shareholders, and, therefore, are under the obligation to obtain the full amount on each dwelling sanctioned by their special Act of Parliament.

---

* As also the rental.

† A most important part of the 'domestic' supply.

Parliament alone can remedy the anomoly of the monopoly in water supply, and until then each dwelling will continue to have cause for serious complaint, and each one of the community will continue to suffer painful ailments to the shortening of life.

Were an example necessary as to charge for water supplied, we have only to take the case of rival omnibuses, when the fares are reduced to the penny, and half-penny, but as soon as the rival is beaten off the road the fares are put back to their former amounts. It is also to be found in connection with labour—scarcity, or excess rules the rate of wages.

Who gains thereby, rejoices! Who loses thereby, complains!

But the sufferers, however poor they may be, are entitled to their remedy, as no privilege is consistent with the acknowledged principle, "Do unto others as you would wish to be done unto."

Each holder of water stock hopes to get the largest possible dividend, at the same time every effort is made to obtain materials, plant and labour at the lowest contract prices to increase those dividends.

Extract from the "Journal of the Society of Arts."

WATER SUPPLY OF TOWNS.

The following letter has been received from H.R.H. the President of the Society:—

CLARENCE HOUSE,
ST. JAMES'S, S.W.,
January 30*th*, 1878.

SIR,

The supply of pure water to the population is at the present time exciting deep interest throughout the country.

. . . . .

While the larger populations are striving, each independently, and at enormous cost, to secure for themselves this article of prime necessity, the smaller localities must make the best shift they can, and in many instances are all but without supply at all.

. . . . .

Under these circumstances, I would draw the attention of the Council to the subject.

. . . . .

I have the honour to be, SIR, yours faithfully,

(Signed) ALBERT EDWARD P.,
President of the Society of Arts.

To the Chairman of the
Council of the Society of Arts.

"The Board of Trade was horrified, and intelligently horrified, at the position in which Parliament found itself in respect to the Water Companies."—THE MARQUIS OF SALISBURY, *House of Lords, March 1st, 1887.*

"But water, I deem, hath a mightier claim;"

"How soon we find it is better than gold!"
Eliza Cook.

Our Daily Water Supply.

PART I.

Bodily Ailments frustrating Life enjoyment.

THE first thing each one requires on becoming one of the human family is water. From the infant to the aged water enters into all the compounds and admixtures for our daily wants. Beverages and food cannot be produced without water. Day after day we pass on to years, and our existence is wholly affected by ailments of divers kinds. Disease attacks the human family in its various forms; and with all the outlay by Water Companies, and the supervision of corporate bodies in the interest of the public health, the result is not satisfactory. Every house is supposed to have an adequate supply of potable water for all domestic purposes; and of late years the attention of the medical profession has been directed to the numerous bodily complaints which are attributed to imprudence, to family transmission, to local defects, and other sources, as to all of which there must be doubt and miscalculation. Seldom is the cause sought for in the house water, and yet the ailment and unhealthiness must arise from the hardness and the polluted * condition of the water in the house cistern for daily use.

Filter-beds conducing to ill-health.

In each Act of Parliament of the water companies, granting the special powers to supply a community within the defined area, precautions are prescribed to ensure good potable water to each consumer, and for that purpose the Water Company have to construct reservoirs and filter beds spreading over many acres of open land. The filter beds for the Metropolis and the principal provincial towns are surrounded by factories and working-class dwellings. The position of these filter beds cannot be favourable to the quality of the water supposed to be free from all the impurities of land drainage, and the contamination of refuse matter of outlying districts, and the sewage matter from barges, river craft, and house-boats. This state of our drinking water being an admitted fact, not only in the monthly official reports, but also under the seal, respectively, of several Royal Commissions on the pollution of rivers, from which the water for domestic and all other purposes is drawn, it is evident that the water supplied to each household within the area of the supply Company must be of a character injurious to health, personal comfort and the happiness of the family circle.

* See Note, page 73.

All surface water unwholesome.

If the water be taken from a river it must be the drainage from surrounding districts, and hence it is no exaggeration to characterize it as containing the germs of living corruption, which, imbibed in our daily food and beverages taken either cold, or hot, must engender disorders and ailments that will continue to defy medical science. If the water be taken from house wells, it cannot be otherwise than polluted by the drainage of garden land, and with sewage matter ; and in localities of working class tenements, the liquid matter from the privies, or cesspools, will inevitably contribute its quantum of human excreta to be absorbed at the family table in the preparation of the frugal meal, child and adult alike partaking thereof.

Mineral Waters may be injurious.

If the water be taken from artesian wells in specially selected positions, iron, chalk, and other minerals, may affect the water.

Water obtained through chalk is filtered to complete purity as to insect life, but the water then by reason of the carbonate of lime, either in suspension, or solution, is hurtful, and defeats the primary laws of hygiene.

All other artesian well water, with its mineral constituents, cannot be free from organic matter, and so is hurtful from both these causes.

Renewal of the Human Frame.

The digestive organs are by nature prepared to extract from our daily food and beverages those elements essential to the renewal of blood and of bone, and those elements can only be procured from meat, fish, cereals, vegetables, fruit, potatoes, succulent roots, water and other plants. All these contain in their formation the salts, phosphates, and lime, duly prepared for the strengthening of the human body; but the introduction of minerals in solution, or suspension through the water used daily in the preparation of beverages and food, must, as a consequence, be the cause of serious ailments at all ages.

Daily complaints of all classes of both sexes.

Stone, gravel, chalk stones, chalk gout, cramp, gripe, constipation, &c., are assuredly caused by hard and by polluted water. These complaints are the cause of ailments giving constant pain in the head, body and limbs, resulting in mental depression, and a lowering of the whole system.

The Fretful Infant.

In the compounds for infants water enters largely, to which may be traced the larger proportion of infantile complaints, rendering the offspring fretful and restless.

Hard Water—Action on the Body.

Our daily ablutions are for the purpose of freeing the skin from the exudations under exertion. The pores of the skin are the channel through which the impurities of the body are carried off. Check this action of nature, and the human mechanism is thrown into disorder, thus leading to very serious consequences to health and mind.

The use of the bath daily is of no avail, even at the highest bearable temperature, if the water be hard, for, notwithstanding all the friction under strong soap-lather, skin disease must result. Soft water alone can remove the perspiration from the pores of the skin, and so leave them free for successive exertion. Even with the daily bath it will be admitted that there is a clamminess of limb on emerging from the water, which denotes that the skin is not thoroughly cleansed. But, besides the perspiration still filling the pores, the soap used cannot be removed by reason of the hardness of the water, and hence a paste of the most hurtful compounds is spread over the skin, creating irritation, and eventually disease obnoxious to oneself and repugnant to others.

Soap-curd on the bath-water will be sufficient evidence that the skin cannot be effectually cleansed of the impurities of the body that must pass off through the pores ; and this being an indisputable fact in this simple language to be at once understood by every human being, clearly illustrates and demonstrates that the hygienic condition of the body is not reached to the required degree of completion every twenty-four hours, and in this state of defective cleanliness our feelings, our enjoyments, our sentiments, must be painfully affected and depressed, and unable to rise to that delight of human existence nearly equal to the presumable bliss of the spirit world.

Let us not stop short at the cultivated and refined portion of the community in this matter of hygienic bodily treatment.

We are all responsible for national disasters, and individual neglect producing those calamities, that decimate whole regions under the mantle of dire disease, from which the needy and the suffering poor have no escape, but from which the wealthy can take flight in time to other latitudes. This immunity through the agency of gold is not christian, or even humanitarian, as implied in the bond of brotherhood, or of national help. Death in the course of nature, or by accident is awful, and fills one's mind with continuous anguish at the sorrowful events that must follow; but when it is hastened by human action, governed and influenced by motives of sordid gain, as is the case with water supply, life then becomes a continuous suffering until the vitality of the brain is completely exhausted, and only to be compared to the torture of the inquisition, converting our days and nights into ceaseless agony. Epidemics are engendered by the foulness of the creature, originating with neglect of the body and the surroundings. Poverty and impecuniosity are the parents of those periodical visitations, making victims of the helpless, and thus converting the busy mart of yesterday into a charnel house on the morrow. Hygiene for the people is also hygiene for the wealthy, and in each case can only be obtained by sanitation, both of which depend entirely on personal cleanliness, to ensure which soft water is an imperative necessity.

The wealthy conform to the laws of nature by a strict observance of her requirements, giving the full length of time daily to the bath, and the thousand and one accessories of the toilette. The daily worker cannot possibly give the time thereto in respect of his person, as by doing so daily much of the time that constitutes the daily wage to provide life's sustenance would be absorbed in this *luxurious* habit.

Humanity is in direct contradiction with itself, as the artizan provides the wealthy with the source and facilities for personal cleanliness, and consequent comfort, to the neglect of self, at the risk of propagating the most revolting disease—that of the skin.

The reader may well feel disgusted at such possibilities occurring in the higher strata of society, but all humanity being equally susceptible of atmospheric influences and action, the cause of disease in the one individual of the labour class must alike result in similar disease to the wealthy, as immunity cannot be insured, notwithstanding all the compounds and combinations, and supposed preventions that the ingenuity of industry and science can offer. Were it possible to be effective with the more refined classes, then gold should not be the obstacle to the million having that safeguard provided, for it should then be the duty of the state to make the recognised safeguard a national obligation. But is there an absolute safeguard in the various compounds under as many designations periodically discovered, and when brought to light are offered to the public as possessing all the virtues and powers of restoring health, vigour, and beauty to the skin ?

Of these numerous compounds may be described the common " yellow " and " mottled " soap as the most antiquated of all saponaceous manufactures, and these are composed of resin, gum, vegetable oils, animal fat, with an alkali. The marketable price of these soaps to provide for competition in trade induces the maker to work up the cheapest ingredients,* and for that purpose the alkali used is hurtful to the skin, creating irritation, and even sores, both of which are solely attributable to the low class of commodities, with a view to obtain the largest profit at the keenest competitive prices, made more so by the rivalry of foreign manufactured soaps.*

This is an era of substitutes, and in the matter of alkalis, chemicals of a deleterious nature are used in their stead ; * and in support of this assertion we may take the malt and hops which are now replaced by most *vicious* compounds ; and again, the once prohibited chicory is now imitated by an obnoxious production. In fact, adulteration and substitution spread over every household commodity.

---

* Recent trade announcements in " Soap " and " Laundry " Publications justify these statements.

Whilst bathing in water at a fairly high temperature, the curding of the soap-lather must be indisputable evidence, that the skin cannot be properly cleansed or freed from the exudations through the pores under exertion, or even moderate exercise. The curding of the soap on the surface of the bath-water must also make us conscious that the pores already filled up by the soap and perspiration combined will so continue until irritation is followed by rash, or outbreak of an exanthematous character. Whatever may be the eruption on the skin, the same is of a most virulent poisonous nature which, if thrown back into the system by chill or exposure to draught, or damp atmosphere, will terminate fatally, irrespective of social position, and other distinctive conditions depending on class.

By the laws of mechanics gravitation continues to the lowest point or level, so in the human body all the residuum of the blood's action must fall to the extremities—the feet.* These being by national custom, fashion, or climatic necessity enveloped in hose and then encased in leather coverings, styled boots and shoes, it can be easily imagined how necessary it is for one's health, hygienic condition of the body and skin, and the vigour of the mind, that they should be thoroughly cleansed of the daily impurities. This cannot possibly be in the use of hard water. The production of an effective soap has exercised the scientific, the scientist of every nation of the globe, but the practical result is still unfavourable to hygiene, and to sanitation.

---

* Terrible diseases are transmitted by second hand, and old boots and shoes.

No one can seriously assert that sea bathing is truly a cleanly habit, for after a sea bath the skin is clammy, and therefore liable to become foul and finally diseased. The thoughtless conclude that the intermittent shiver and the coldness are indications of hygiene, whereas they are the thermometer of a system in the course of disorder.

If hard water heated at various temperatures will not cleanse the pores of the skin, how can it be supposed that sea water at a frigid temperature can be at all healthy ? the one, therefore, being proved ineffective, the other follows naturally in the condemnation of being anything but hygienic. Unless the water be soft, it is in vain to seek for that cleanliness of the skin, without which there is no real enjoyment in our pursuits, whether of pleasure, or of business. Many of our ailments (supposed to be constitutional) are due to the imperfect hygienic condition of the skin. Such being the state of society from the highest personage of the realm to those possessing sufficient resources to provide daily the possible comforts of life, how horrible must be the life of the daily toiler moving about in trade and industrial activity, and in the preparation and vending of our food and beverages !

Baths, Laundry and House Utensils cleaned with hard water.

Having demonstrated as to the skin, the same applies to the bath, the walls of which are always covered with the curded soap and exudations of the skin. Imagine the consequences that will be inevitable in the use of a bath by the many, consequences that can only be escaped by the bath being exclusively for the use of self, or one person; and where is the home, the hotel, the dwellings of the poor, or the common lodging houses wherein arrangements can be made for distinctly exclusive baths? Then comes the unpleasant avowal of the continuous propagation of the most revolting of all ailments—skin disease*—communicated by the very effort made for the purpose of cleanliness which by unconscious neglect renders hygiene literally impossible, to the discomfort and sufferings of self and one's surroundings. The same may be irrefutably said of the laundry tubs, bowls, scoops, machines, coppers, &c.; of the kitchen and scullery utensils, and the whole of the household vessels, all of which may engender disease, through carelessness and thoughtlessness.

To establish the comparison between home utensils and the human skin, it will suffice to assert that the exudations through the pores of the skin are of a fatty nature, exactly similar to the greasy coating of every vessel for our home wants. If hard water fails to remove the oleaginous surface of the skin, it must also fail to remove the fatty coating of the culinary vessels.

---

* The multifarious nostrums offered daily for the cure of skin disease prove that it exists under many forms.

Examine the steam pipes of an engine, and the complete stoppage thereof by the constituents of the water will make it patent to the most inexperienced, the like result to hot water pipes and vessels of the home, and to this incrustation and choking of the steam and hot water pipes may be attributed every case of boiler explosion in mines, factories, hotels, private houses* and dwellings wherein hot water arrangements are in use. Another source of considerable danger, arising from hard water, is the periodical chipping of boilers, through the incrustation bringing off the surface of the metal, thus weakening the plates.

Hard Water in the preparation of Food.

Beginning with bread, pastry, and other farinaceous compounds, hard water must be a deterrent to lightness† thereof, so essential in the action of the digestive organs. In the boiling of meat the fibre cannot be otherwise than tough when the water is hard. As regards potatoes, the best mealy will become waxey in hard water. All vegetable produce in hard water will not only fail to attain the required softness, but will also fail to give off that injurious moisture produced by the coarse manure used on the land in cultivation, and which may be estimated in strength by the offensive odour and flavor of the water under partial extraction.

---

* While this treatise was in the press two kitchen boilers exploded in London, resulting in the instantaneous death of the caretaker in the first, and of the son, aged 13 years, in the latter catastrophe.

† A recent case of food poisoning at an agricultural banquet by the use of washing soda to soften the peas served with boiled beef occurred at Carlisle, nearly 100 persons being sufferers.—*Daily Press.*

Hard Water for our Beverages.

The tea leaf requiring the greatest care in its infusion, that all the delicacies of flavour may be preserved, hard water cannot be otherwise than injurious in the brew of tea.

Coffee is likewise susceptible of the deleterious effects of hard water, and thereby rendered unpalatable, destroying the beneficial extract and also the aroma, or only giving each partially.

As in tea and coffee, so must it be in beer and every other beverage. In each case, a material and a pecuniary loss are the result.

A conclusive illustration of the injurious effect of hard water is to be witnessed in its use upon vegetation, and on flowering plants in particular; whilst thriving under rain water, they sicken and droop under hard water, which affects in the same manner and degree our food productions by destroying the nutritive properties so essential to our health and comfort.

Hard Water for Laundry Work.*

The body and house linen, flannels and blankets, woollens and cottons, and other textiles, must in hard water undergo extra friction and rubbing, whether by hand, or in the machine, causing the "wear and tear" to be more rapid, and in the case of laces, muslins, gauzes, silks, cambrics, and of the more delicate of textile fabrics, whether passed through the home, or public laundry, or the dyers and cleaners' processes, will result in unnecessary destruction thereof; at the same time the impurities of the body from wear and usage are not removed, or destroyed. Linen and cotton textiles become yellow, and flannels have a dull appearance, and a harshy feel by the non-removal of the dirt.

---

* The trade announcement of Special Laundries is, "No Chemicals or Brushes used."

Hard Water for Textile Manufactures.

In every industry water is the first element either directly, or indirectly, at the first stage, or subsequently, and when hard, as is generally the character of local artificial supplies (sunken wells), the commodities of every kind are seriously affected in their trade value, and textiles are rendered brittle as the consequence of the use of hard water. Silks and satins are particularly susceptible ; yarn, when prepared for the loom in passing through the steeping process, and the thread and cotton for the spool and ball.

The Infant's and the Child's Ablutions in Hard Water.

What an unpleasant time daily for the household while the infant, or the child, is undergoing the process of washing. The tears that are shed by the offspring, the shudder it evinces at the sight of the water must make it evident that pain is caused. Who, on reflection, can be surprised that the extreme friction of the tender skin, owing to the hardness of the water and thus leading to apparently rough handling, which is generally added to by the impatient parent, and nursery attendant, that the infant and child should become fretful? Little heed is given to the excessive pain in the eyes by the water and the soap-lather.

Hard Water on the Skin.

As it is already stated the skin, by reason of the hardness of the water, is not only liable to disease, but engenders the most perfect corruption known by the name of maggots. These are easily observable in the nose. In support of this, draw the finger nail down the skin of the nose under moisture, and it will then be seen, by the aid of the microscope, that from the pores maggots have been withdrawn. Is there anything more unsightly than the thousand and one black specks on the surface of the nose, these being so many heads of maggots? In biblical history the leprous general is an instance of the loathsomeness of skin disease, at which the mind of each one must revolt. Who can say, when we consider the leprous condition of tens of thousands of our fellow countrymen, women and children suffering on, incurable, that the scripture general's condition was worse than what now exists from day to day during lifetime, in the form of contagious disease of the skin, propagating from generation to generation, to the dismay of the family circle and the repugnance of society? As it cannot be denied that any kind of skin disease is a poisonous germination of insect life arising from the impurities of the blood, checked in their passage through the pores of the skin by the hardness of the water for all bodily requirements and household purposes, it can be no matter of surprise that the outdoor trade on barrows must be a positive source of grave danger to each one partaking of those commodities. There is an impression, that in the process of cooking, the germs of insect life are destroyed by the heat of fire, or by boiling water; but this action of fire and of boiling temperature is insufficient to destroy germ life totally, and where it may be destroyed the dead germs as rapidly produce new germs of corruption equally dangerous to the blood as well as to the skin.*

Hard Water conduces to Blood Poisoning.

Blood poisoning is the result of an unhealthy condition of the skin, in consequence of there being no escape through the pores of the skin of the life germs imbibed, or inhaled. The gases that are generated in sewers, drains, receptacles for refuse matter, ill-constructed wells for water supply, &c., are sources of dangerous sickness individually. In towns, where defective drainage still exists, notwithstanding the outcry and the many *HEALTH EXHIBITIONS* and *CONGRESSES*, epidemics will continue their ravages so long as the water is used in its condition of hardness.

---

* A perusal of Mr. Milton's "Hygiene of the Skin" is recommended.

Soap used in common for Linen in Hard Water.

It is futile to expect that clothes soiled by our daily exertions can be effectually cleansed from the impurities of the skin by means of soap used in common in the laundry. It must be a source of constant propagation of insect life through the agency of soap-lather, notwithstanding the use of chemicals, alkalis, and deleterious compounds, these having no destroying properties for life germs, and resulting in body linen and flannels being worn repeatedly in an unsanitary condition.

Cause of Epidemics by reason of the hardness of Water.

In every country poverty is the origin of all uncleanness, and hence every community possesses its share of filth. In Great Britain the frequent rainfalls, the bleak winds of autumn, winter and spring, and the long hours of labour make it impossible for the bath to become of daily use in the homes of the working classes, and by reason of this omission—nationally—periodic distempers, sickness, disease, and pestilence work havoc amongst the daily toilers, one case sufficing to spread rapidly amongst those ever susceptible of contagion, by their mode of living through the various atmospheric changes of each season. Epidemics are not restricted to any particular weather, month, or year, and to look upon them as a visitation from Heaven is to offer a gratuitous insult to the Almighty Creator.

Soap used in common for the Body in hard water.

It is a practice in every household, hotel, in bathing establishments, and other public lavatories, to use the piece of soap in common. A more sure medium of contagion cannot exist even amongst the members of a household. The reflection must fill the mind of the reader with horrible misgivings, at the disgusting consequences of the use of the soap already handled by the many to remove the impurities of the skin, caused by activity and exertion, and the necessitous habits of each one. But how soon contagion may be carried into the most healthy home, and the inmates stricken down with sickness and disfigured for life through imprudence and thoughtlessness in the use of soap in common. Whether it be in hot, or cold water, the character of which is hard, the germs of corruption are in no way destroyed, or affected, but merely transferred from one person to another in the saponaceous paste or softened coating of the soap. As long as the skin is not thoroughly cleansed of the daily impurities, the piece, ball, lump, or cake of soap, be it of any class whatever, will undoubtedly be impregnated with so much of the impurities and particles of the skin as may be removed by friction. Disease and its germs, varying in the thousand forms known and unknown, are communicated from one to the other by the hand towels and bath linen. No further proof need be required than the examination of the towel after use, showing distinct marks of uncleanness on the skin, for, were the skin thoroughly freed from the exudations of the pores, the towel would show no other than marks of moisture. The dirt marks are indisputable evidence of the daily condition of the skin and the blood, hence the splenetic disposition or low morbid state of the British people.

We wander abroad to gather from neighbouring and eastern countries the habits and customs of daily life, and the immediate causes of their periodical diseases and epidemics, and the precautions observed, socially and officially.

Those entrusted with the enquiry, investigation, and research furnish the most elaborate reports, appendices, tables, and statistics, upon which to base conclusions that may result in a reduced mortality or death rate by compiling sanitary laws, rules and regulations against the importation of foreign contagion, epidemic, or pestilence. This is well, and the duty of the government and the local authorities would be most effectual, but with the flashed intelligence, from the latitude of the prevailing epidemic, our ruling powers and local authorities awake suddenly to the consciousness that our centres of industry, our toiling classes, our storage arrangements, our house sanitation, the disposal of all sewage matter, of all refuse, garbage, and accumulated filth, our over-crowded dwellings—to the extent of many tens of thousands of fellow creatures huddled together winter and summer in the abjectness of privation, crime, and street occupation, with the water-closet defective, and the water-cistern conveying at every turn of the tap the most horrible of organic life and of putrid matter, require attention. The French axiom " Ne laver jamais le linge sâle en publique," is forcibly applicable in its purely literal sense to the British people, for although every effort is made by each of us to ensure sanitation and hygiene, the difficulties to accomplish our aim are insuperable as regards individual effort, but with the Government and local authorities and the thousand-and-one Acts of Parliament by which millions sterling pass from the people's earnings into the treasury and municipal coffers each month, every nook and corner of " old England " could be bright and happy under the influence of perfect sanitation and complete hygienic condition of the body—the infant, the child, the adult alike, irrespective of social degrees. Our scriptural text, "Cleanliness is next to Godliness," could be fully realised by greater unity in the action of the ruling powers, and with a mind influenced by the soothing effect of sanitation and hygiene, godliness would be more deep rooted and more easily accepted from those who labour earnestly and devotionally in that one field of culture, notwithstanding the variety of the seed sown. Health and contentment lead us to look upwards in gratitude; but low condition of the body through want, poverty and destitution causes a downcast look to the extinction of gentleness, patience and virtuous thoughts. The moral teaching of Christ was "cleanse the body of all impurities first, and then the mind will pour forth its thanks to God." The maimed, the halt, the blind, the leper were all made whole to understand Christ's teachings. The unbelievers, the sceptics, need not smile, for if considered in a figurative sense, it is logically and mathematically correct. Do not all peoples undergo ablutions just previous to partaking of their daily food? Then, if it be a ceremony and form due to self and to one's table companions, how much more is it necessary to receive in an undisturbed state of mind the grace of godliness?

Should the skin be in an unclean condition, it will readily receive the communicated germ of disease, and at once multiply it. As with man, so with the lower orders of creation, every species is busy with its propagation, the laws and distinctive characters of which we know absolutely nothing to enable us to annihilate the species.

With the Eastern peoples the bath is the studied *luxury* of every day, of which we have discovered proofs in the ruins of Pompeii, of Rome, and other ancient cities of the far Orient. This daily *luxury* is offered to the British public by the introduction of the "Turkish Bath" in all the principal towns of the Kingdom. But, considering our national customs, established by our industrial and commercial necessities, the Asiatic *luxury* cannot possibly be generally adopted. Again, the many changes of temperature are a serious impediment to the enjoyment and satisfactory hygienic results of the vapour bath.

The constituents of waters vary according to the geological formation under the following heads:—

Ammonia
Carbonate of Lime
Carbonate of Iron
Chlorine
Muriate of Soda
Muriate of Lime
Muriate of Magnesia
Nitrogen
Nitrogen, as Nitrates and Nitrites
Organic Carbon
Organic elements
Silica
Solid matters
Sulphate of Lime

GASEOUS CONTENTS.

Azotic Gas
Carbonic Acid Gas
Sulphuretted Hydrogene

Chemistry may discover other elements in various waters, but the foregoing will be sufficient to guide the head of each household in the urgent effort to avoid injury to health of the inmates. The character of every water will inevitably change as that of the human being under the influence of temperature, abundance, scarcity, dryness, and rainfall, to which may be added the drainage of manures, and the daily necessities of thickly populated localities.

Soap may be the vehicle of the most distressing diseases of the skin of the classified nature hereunder:—

- Dandruff
- Eczema
- Eruptions
- Itching
- Scrofula

As hard water will hermetically choke steam pipes and incrustate boilers, it will contribute to the propagation of disease germs through the soap under lather. But as the softened water will remove the old flinty accumulations in steam pipes and boilers, leaving them as when newly fitted, so will softened water cleanse the skin of all impurities the cause of many terrible family diseases, and the soap of the impregnated lather.

Can anything be more convincing in the horrible and revolting accumulations of skin dirt, than the living corruption it produces on children neglected only for a few days? and this in consequence of the water being hard and contaminated. Foul elements must produce other foulness.

In illustration of the absolute evils of hard and polluted water, the following Royal Commissions and Committees have been appointed by the Sovereign and Parliament to inquire into the condition of the water supply of the United Kingdom, and to report thereon:—

ROYAL COMMISSIONS.

Report, dated 1828
,, ,, 1866
,, ,, 1867
,, ,, 1867
,, ,, 1870
,, ,, 1870

Report, dated 1871
,, ,, 1872
,, ,, 1873
,, ,, 1874
,, ,, 1874

LORDS' COMMITTEES.

Report, dated 1840

Report, dated 1873

SELECT COMMITTEES—House of Commons.

Report, dated 1821
,, ,, 1828

Report, dated 1834

The above list of reports is established proof that the character of the water for our daily requirements has given rise to periodical complaints of defective sanitation and hygiene, and therefrom extracts only will be taken, in support of the views now offered to the British people, as to the water supplied by the Water Companies and Local Authorities.

"As to Hard Water."

In the sixth report of the Royal Commission of 1874, pages 21, 22 and 23, Nos. 9, 10 and 11, the analytical results of the various water resources, basins and reservoirs, throughout the United Kingdom, the several characters of water are thus described—

" Hardness is produced by some of the mineral substances which are taken up in solution. Hard water decomposes soap, and cannot be efficiently used for washing." The chief mineral substances are " Salts of Lime and Magnesia." "In the decomposition of soap, these salts form curdy and insoluble compounds, containing the fatty acids of the soap, and the lime and magnesia of the salts. So long as this decomposition goes on, the soap is useless as a detergent . . . . The pores of the skin are filled with insoluble, greasy, and curdy salts of the fatty acids contained in the soap, and it is only because the insoluble pigment produced is white, or nearly so, that such a repulsive operation is tolerated."

" Of the hardening salts present in potable water. carbonate of lime is the one most generally met with ; . . . . . a sample containing 1 lb. of carbonate of lime, or its equivalent of other hardening salts in 100,000 lbs., is said to have one degree of hardness. Each degree of hardness indicates the destruction and waste of 12 lbs. of the best hard soap by 100,000 lbs., or 10,000 gallons of the water, when used for washing."

" . . . . . A constant supply of hot water has become almost a necessity in every household, but great difficulties are thrown in the way of its attainment by the supply of hard water to towns, owing to the formation of thick calcareous crusts in the heating apparatus."

At page 4, the constituents of water are designated in the following order:—

"IN SOLUTION.

1. Total solid matters, or total solid impurities.
2. Organic carbon, or carbon contained in the organic matter actually present.
3. Organic nitrogen, or nitrogen contained in the organic matter actually present.
4. Ammonia.
5. Nitrogen as nitrates and nitrites.
6. Total combined nitrogen.
7. Estimation of the previous sewage or animal contamination.
8. Chlorine.
9. Temporary, permanent, and total hardness.

"IN SUSPENSION.

10. Mineral matters in suspension.
11. Organic matters in suspension."

At page 24, part II., the "classification and chemical composition of the potable waters of Great Britain" are given, comprising:—

CLASS I.—Rain water.

CLASS II.—Upland surface waters, these being specified in

DIVISION I.—Waters from non-calcareous strata; or strata which contain neither carbonate nor sulphate of lime.

DIVISION II.—Waters from calcareous strata.

The first Division is subdivided into four sections, and the second Division into five sections.

Class III.—Surface waters from cultivated lands.

Class IV.—Shallow well waters, these forming fourteen sections.

Class V.—Deep well waters, particularised in Divisions I. and II., and subdivided into eleven sections.

Class VI.—Spring waters under "Divisions I. and II. and fourteen sections at page 22. The hardness of rain water is given as varying from 0° to 10°, the increase taking place towards the sea shore and in rough weather.

At page 3, part 1, the "atmospheric gases" are tabulated as

"Nitrogen
"Oxygen
"Carbonic Acid."

"The *exhaustive* chemical examination of a sample of water is one of the most tedious and troublesome operations known to chemists. It requires weeks, sometimes even months, for its completion."

Geological formations are governed by natural laws, over which human action has no influence, and hence is regulated the supply of water. The various strata must undoubtedly affect the character of the water in each section of the earth, and to this belongs the varied hardness, more or less injurious and hurtful to health, by impeded sanitation and hygiene. At page 22, the hardness from mineral and organic matters is stated to vary from:—

0° to 5°9	9°8 to 27°9
0°4 „ 32°5	9°9 „ 191°
0°9 „ 48°5	10°3 „ 50°
2°3 „ 75°	12°4 „ 38°
4° „ 44°	12°4 „ 50°
5°7 „ 35°7	14°7 „ 67°3

"As to the Supply of the Metropolis with Spring and Deep-well Water.

"Abundance of spring and deep-well water of excellent quality can be procured in the basin of the *Thames*, and within a moderate distance of London; and we are of opinion that the metropolis and its suburbs should be supplied, on the constant system, exclusively with this palatable and wholesome water.

"The Softening of Water by Lime.

"*We recommend that this water should, before delivery to consumers, be softened with lime.**

"The introduction of this new supply of wholesome, palatable, and soft water will render necessary, either the throwing open of the metropolitan water supply to the competition of new private companies, or the transference of the control of that supply to a responsible public body invested with the necessary powers for the purchase of the existing works, and the construction of such other works as may be required for the acquisition and supply of so much spring and deep-well water as may be necessary to replace the river water now delivered in London and its suburbs. Of these two alternative measures we give strong preference to the last.

---

* These remarks of the Royal Commissioners are here put in italics as deserving the special attention of the reader.

"*It is a valuable property of the chalk spring water, that in practice it may be softened fully or partially with the same facility, or to any degree desired; the precipitate falling quickly and completely in every case, and leaving the supernatent (or filtered) water clear and colourless.**

"Clark's method is equally efficacious in softening all three kinds of water; indeed, the water of the *Thames* and *Lea* is chiefly Chalk spring water similar to that delivered by the Kent Company, but soiled by filthy impurities. Besides softening *Thames* and *Lea* water, however, the treatment with lime also removes from them a considerable proportion of organic impurities." . . . .

Professor Clark's Process.

At page 206 of the Report of the Royal Commission, 1868-74, is the following:—

"This process of softening received the careful attention of the Commissioners appointed by the

---

* These remarks of the Royal Commissioners are here put in italics as deserving the special attention of the reader.

Secretary of State for the Home Department, in 1851, to investigate the quality of the water available for the supply of the Metropolis . . .

They reported as follows upon Clark's process :—

. . . "other means of improvement of the present supply have been brought before us, and engaged much of our attention, namely, ... as proposed by Professor Clark . . . . A careful series of experiments made in the laboratory left no doubt on our minds that the means of conducting this process are certain in their results . . . . . The water of the experiment of the 17th of April, was analysed before and after the softening. The whole fixed constituents contained in one gallon of water were found to be reduced from 24·07 to 8·31 grains, and the organic matter from 2·50 to 1·60 grains. At the same time that the quantity of lime salt present (considering it as carbonate), was reduced from 13·65 to 2·63 grains. THE SOFTENED WATER WAS CLEAR AND BRIGHT, HAD ACQUIRED NO ODOUR NOR TASTE FROM THE PROCESS, AND COULD NOT BE DISTINGUISHED IN ITS SENSIBLE QUALITIES FROM PURE SPRING WATER OF EQUAL SOFTNESS."

"Thames water appeared always to be divested of a certain quantity of both organic and colouring matter by this process, so that its purifying influence greatly exceeds that of sand filtration" . . . . .

"The chalk spring water after being softened is an extremely pure water. It appears to be considerably superior even to the soft water from the streams of the Surrey sands. The chalk water alone is uniform in its excellence at all times, the sources of it lying beyond the influence of weather or season. In the judgment of the Commissioners, this softened chalk water is entitled, from its chemical quality, to a preference over all others for the future supply of the metropolis. It is no longer possible to disregard the chemical means of removing hardness, or to represent them as impracticable on a great scale; they place the question of water supply upon an entirely new footing."

"This report was written twenty-three years ago. In the meantime a knowledge of the elements of chemistry has been spreading among engineers, and others, and the practicability of this valuable process upon a large scale can now be no longer doubted" . .

At page 226, The Right Hon. Lyon Playfair, M.P., C.B., F.R.S., states:—"I have had occasion to observe in my laboratory, that when I was working with any particularly nasty vapour the water of the cistern got to smell offensively of it, and that, therefore, water is very absorptive and apt to dissolve those vapours readily."

At pages 189 and 249, The Right Hon. Lyon Playfair, C.B., M.P., F.R.S., at that time professor of chemistry in the University of Edinburgh, was a member of the Royal Commission for the health of towns, and was for a long time chemical adviser to the Board of Health of London. The quality of the water had, therefore, very frequently come under his consideration. He gave the following evidence :—

"The water supplied to London is decidedly hard water. The effect of a hard water upon its ordinary detergent use is seen in the waste of soap and the difficulty of washing.

. . . . . .

"At a very great difference of price I would give the preference to soft water, because the economy in manufactures is so enormously great with soft water.

"In some cases hard water might prove injurious as in calculous infections and in dyspepsia . . . . In all cases I strongly recommend towns not to accept hard water. I have been consulted with regard to supporting a Bill in Parliament for a water supply to a town and I refused to support it because it had a water with 20 degrees of hardness.

"I believe that it is a misfortune that a large metropolis like this is supplied with a water so hard.

"I have seen evidence given in cases of water supply, not only that it was desirable for health, but that it was absolutely necessary for the formation of the bones. But that showed a lamentable want of chemical knowledge, because the lime required in food does not come from the water, but from the solid articles of food taken, and I do not think that the lime in water has any influence on the processes of healthy nutrition." *

"The economy which carbonate of soda exhibits in comparison with soap, as a softening agent, is far surpassed by that which results from the use of lime for this purpose. The latter material costs only about 8d. per cwt., and this weight of lime will do the work of 20¼ cwts. of soap in softening hard water. To soften a quantity of hard water which requires 1 cwt. of lime the following would be the weight and cost of the three alternative materials:—

	£	s.	d.
1 cwt. quicklime	£0	0	8
4¾ cwts. carbonate of soda	2	17	9
20¼ cwts. soap	47	1	8

"There is thus an enormous economy in the use of lime, and in the discovery of this process the late Dr. Clark, Professor of Chemistry in the University of Aberdeen, conferred a valuable boon upon the inhabitants of many hard-water districts.

"As to the Softening of Hard Water.

"Water, the hardness of which is wholly or chiefly of the temporary kind, may be easily, cheaply, and efficiently softened on the large scale by the proper use of lime, and the wholesomeness and palatability of such water are sometimes increased and never diminished by the process.

---

* The evidence of Sir Lyon Playfair is fully confirmed in his letter of December, 1886, to the Author.

"The lime method of softening may be applied with ease and great economy to the whole supply of even the largest towns, provided the hardness of the water be wholly or chiefly of the temporary kind.

"Evidence on this subject was given before the Royal Commission on Water Supply (1869). The greater economy in the household from the use of a soft water was generally admitted; but as in the case of the *Thames* water the hardness arises mainly from the presence of the bicarbonate of lime, which is deposited on boiling, the objection to the use of hard water for culinary purposes, which was principally insisted on, is the manner in which deposits take place from it in kettles and boilers.

"The late Professor W. A. Miller, M.D., F.R.S., said:—'I think that one of the principal objections to hard water is the manner in which deposits take place from it when it is used in boilers. There is always in a chalk district a considerable deposit of hard adherent fur in the inside of boilers, kettles, kitchen ranges, and so on, which in time chokes the range and obstructs the passage of heat, and may occasion accidents; that seems to me to be one of the serious practical inconveniences from hard water.'"

At page 184, division III, of the Report of the Royal Commission, 1874, is this reference:—

"The late Dr. Todd Thompson states, in his work, on the domestic management of the sick room, 'the best and the most universal drink is *water;* but the qualities of water differ according to the source whence it is procured. The fewer foreign ingredients it holds in solution, the greater are its diluent properties; thence, either distilled water, or rain or river water filtered, are the only kinds proper for the use of the sick room. Hard water, under whatever name it is found, whether as spring water, or pump water, or well water, should be excluded.' "

The following names of those authorities who gave evidence before the Royal Commission of 1874, against the injurious effects of hard water upon the skin, the body internally, and our daily food will be conclusive.

Dr. JOHN, Sutherland.

Dr. LEECH, Glasgow.

Professor JOHN THOMAS WAY.

Dr. HENRY LETHEBY.

Mr. JOHN SIMON, F.R.S., M.S. to the Privy Council.

Right Hon. LYON PLAYFAIR, C.B.

D. EDMUND A. PARKES,

Sir BENJAMIN BRODIE, Bart.

Professor WILLIAM OLDING.

Professor WILLIAM ALLEN MILLER,

other eminent and distinguished members of the Medical Profession, and Monsieur SOYER, the eminent chef de cuisine.

" Professor Clark, of Aberdeen, gave the following evidence:—'In short, hard water is bad for a first infusion, still worse for a second. The only way of making an infusion of tea with waters at 8°, 12°, or 16°, equally strong with an infusion of water at 4°, is to increase in each case the quantity of tea infused.' "

Fifteenth Annual Report of the Local Government Board, 1885-86.

ANALYSIS OF THE WATERS SUPPLIED BY THE METROPOLITAN WATER COMPANIES.

By Professor FRANKLAND, D.C.C., F.R.S., &c.,
16th February, 1886.—

" . . . . in the laundry, for the production of steam, and for most manufacturing purposes, a soft water, like that of the Colne Valley Company, possesses great advantages over a hard one. In all operations in which soap is used as a detergent, it is absolutely necessary to have soft water, and if the water be not already soft it must be rendered so before the soap can exert its cleansing properties. This preliminary softening is often accomplished by means of carbonate of soda, so as to avoid the still greater cost which softening by soap entails. On the large scale many waters can be softened by means of lime (Clark's process) for about one-eightieth part of the cost of the soap required for the purpose."

Effect of Hard Water in Boilers.*

The following extracts are from the report to the President of the Board of Trade, on the 43 explosions of boilers at factories officially enquired into under the "Boiler Explosions Act, 1882," bringing the number up to a total of 129 explosions investigated by the Board of Trade:—

The 43 explosions resulted in 40 persons killed and 62 injured, as also serious loss and damage to property, in the year ended 30th June, 1885.

Page 23, "The explosion.—It was evident that the presence of an undue amount of deposit there had led to the overheating of the plate; . . . . . . the boiler was cleaned internally every ten weeks.

. . . . . .

Page 31, "Cause of the explosion.—Accumulation of deposit, consisting of salt and sediment.

. . . . . .

Page 34, ". . . . the explosion was caused . . . . through an accumulation of sediment.

Page 39, ". . . . . indeed active corrosion appears to have been general.

Page 55.—ANALYSIS OF WATER USED.

Sulphates of Lime and Magnesia
Sulphate of Soda
Carbonates of Lime and Magnesia
Chloride of Sodium
Silica

---

* As illustrated by W. Stroudley, Esq., Chief of the Locomotive Works of L. B. & S. C. Railway, in his numerous allusions to the wear and tear of Railway Locomotives.

BOILER MUDS.

Calic Carbonate
,, Sulphate
,, Phosphate
Magnesia Oxide and Carbonate
,, Sulphate
Sodic Salts
Oxides of Iron and Alumina
Silica and insoluble organic matter.

Transactions of the Brighton Health Congress, 1881.

DOMESTIC SOFTENING OF WATER FROM THE CHALK.

By W. H. Hallett, F.L.S. (Mayor).

"The benefit to arise from softening chalk-water for drinking purposes is often discussed, but unless a water company undertakes the task, consumers continue to drink the hard water as though no remedy is within their power.

"There is, therefore, very little question that the adoption of some such mechanical means of mixing, combined with a rapid filtering of the separated chalk, would soon be paid for through the large saving in soap.

"Three years ago, when the Warren Farm Well was under discussion, it was said that the soft water obtained from the sand was a saving of many pounds per annum, compared with what would be the cost of using the town water. The town water is now used in its stead, and the time seems to be come for the guardians to consider the use of a softening apparatus fitted for extensive use."

"Morning Post," October 12th, 1886.

SOFT WATER WANTED.

SIR,—The Corporation of the town of Brighton furnishes, at great expense, a magnificent supply of water to the citizens of that town; but, in comparison with the water supplied to London, that water is very hard, and by no means comes up to the standard required for a good water supply. The hardness of the Brighton water is about 18 degrees, and consequently the inhabitants have annually to expend a very large sum indeed for soap, fuel, soda, and for the cleansing of boilers and kitchen ranges beyond what they would require were the Corporation to see its way to softening the water supplied by means of Dr. CLARK's process, or rather, by some improvement on that process, such as the one devised by Messrs. ATKINS, and which has just been adopted by the Corporation of Southampton, and is actually carried out in London at the Lambeth Workhouse. In a visit last week to that establishment, which contains on an average some 1,600 inhabitants, I found that the water supply is pumped up from a well within the precincts of the workhouse to the amount of about 70,000 gallons daily. When the water comes up it has a hardness of about 10 degrees, which is much below that of most of the London waters; but this is at once reduced to 4½ degrees by means of the addition of about one-tenth of the volume of lime water, and the immediately subsequent filtration of the water by Messrs. ATKINS' process. The consequence of this softening of the Lambeth Workhouse water has been that only about one-half of the soap formerly required in that establishment is now used, only a fraction of the soda is needed, and the engineer informed me that his boilers no longer required to be cleansed at great expense, and that his water pipes, which formerly required constant attention, now require none. In Brighton a great deal of dyspepsia is caused by the use of the extremely hard water, and, in a less degree, this is true for London water. Tea infuses very badly in Brighton, and vegetables are boiled with difficulty. Taking these matters into account, I cannot help urging that our London Water Companies, and those of Brighton and other similarly situated towns, should, as soon as they can see their way, afford to the public a supply of soft, and therefore more wholesome and economical, water.

I am, SIR,
Your obedient Servant,
CHARLES R. DRYSDALE, M.D.,
Senior Physician to the Metropolitan Free Hospital of London.

23, SACKVILLE STREET,
October 11, 1886.

Soft Water has no Action on Leaden Pipes.

The Royal Commissioners state:—". . . We have devoted considerable attention to this subject, and have carefully ascertained the behaviour of very numerous samples of water from the most varied sources, in contact both with bright and clean lead, and with the metal in that tarnished condition which it assumes after exposure for a short time to the atmosphere. The results of our observations prove conclusively that the commonly received opinion that soft waters necessarily act upon lead is erroneous.*

". . . Amongst the waters which we have examined, there is not one which acts more powerfully upon lead than that supplied to Glasgow from Loch Katrine, and yet no symptoms have been observed since its introduction into that city fourteen years ago."

At page 206, the Right Hon. Lyon Playfair, C.B., M.P., F.R.S., specially refers to the improbability of *soft water* being affected by leaden pipes more than *hard water*, in the following terms:—

"I have never seen any instances where the softness of the water produced the evil, if the distribution were rightly made. I have seen individual instances of lead poisoning equally with hard water.

". . . There has not been a single case where it has been found, as far as I have heard, that any danger has arisen from the Loch Katrine water flowing through the (lead) pipes."†

The late Professor Clark.

As a tribute to the ability and patient study of the valuable lime process, by which the late Professor

---

* The treatise of Dr. Henry Osborn, M.R.C.P., Lond., M.R.C.S., Eng., Physician to the Southampton Dispensary, Medical Officer of Health of Southampton, contains valuable scientific information under the title "The Action of Water on Lead," 1860.

† See Note, page 32.

Clark established the exact proportions in accordance with the character of the various waters to be treated, his name is mentioned in the Report of the Royal Commissioners, 1868-74, in the following manner:—

At page 205, " Dr. Clark, Professor of Chemistry in the University of Aberdeen, conferred a valuable boon upon the inhabitants of many hard-water districts:—

" Dr. Clark's patent right;

" Dr. Clark's own account of the process."

At page 206, " Clark's process, as proposed by Professor Clark. . . ."

At pages 207 to 216, "Clark's process for softening hard water;

"Softened by Dr. Clark's process;

" Process of Dr. Clark for softening hard water;

" Clark's method is equally efficacious. . . ."

It will thus be seen that twelve pages of the Report of the Royal Commissioners as " Presented to both Houses of Parliament by command of Her Majesty," are devoted to Professor Clark's discovery. The intricate labour involved in his scientific researches may be in a measure gauged by reference to the statement of the Royal Commissioners at page 27 of this Treatise, as to "weeks," and even "months," being required " for its completion."

PART II.

Impure Water.

The daily water supplied for our use by the water companies and local authorities should, by Acts of Parliament passed, which give to each water company the monopoly of supply and prescribe "good potable water," be free from every kind of impurity and contamination. To be brief, such is not the case: every drop of water, whether drawn from the water companies' or local authorities' mains, or from every class of well, or from streams or rivers, or ponds, or storage reservoirs, through cisterns or tanks, is polluted and contaminated to the immediate danger of health and sanitation.

Organic and insect life are, doubtless, the agency for communicating pestilential diseases in more eastern latitudes, and at the description of their close connection with contagious epidemics and diseases we are appalled. But we are not without our national pests of the swamps, the marshes, the ditches, the stagnant pools, of the winged family and those bred in the accumulation of filth and putrid matter in our midst, within our dwellings. Then comes the class of house pests so common in our bedding and our clothing—fleas, bugs, and other crawling vermin, feeding on the skin of each one alternately. No human individual can insure immunity from contagious disease when bitten by insect bloodsuckers and skin vermin, in the course of our daily occupations, and use in common of conveyances, stuffed chairs, and seats in public rooms.

The only possibility of pure water is that obtained through the chalk, such as exists for the supply to the respective corporate towns of Brighton and Hove, and other towns similarly built on a chalk formation, extending in all directions of the compass many miles from the sea shore. Geologically speaking, Brighton and Hove stand, in respect of the depth of chalk, as towns without a rival. Unless water is obtained direct from the chalk without being intercepted by gravel, clay, and sand, it cannot possibly be free from drainage of land, cemeteries, church yards, and sewage matter.

The Fifteenth Report of the Local Government Board (supplement),

Issued under date of April, 1886, by the Medical Officer, Dr. Buchanan, contains tabulated abstracts from the Inspector's reports on the sanitary condition of the metropolis, urban, and rural districts. Those abstracts justify the assertion of Dr. Buchanan that " English medicine holds that cholera in Europe has at times a power of spreading from the sick to the healthy, exerting this power in the presence of filthy local circumstances and most effectively where sources of drinking water have got contaminated by discharges from cholera patients. England puts her trust in measures that shall secure purity of earth, of water, and of air; and regards this purity as sufficient to prevent the spread of cholera in a European community.

. .. . "And lastly—since unpreparedness against cholera is more or less surely indicated by unpreparedness against other diseases which appear and spread under circumstances of soil, water, or air pollution—a number of districts were selected as more especially requiring inspection, for the reason that enteric fever or epidemic diarrhœa was known habitually to prevail in them.

. . . . . .

"In each district that was visited by inspectors of the survey, investigation was made of the general sanitary circumstances of the district with reference to cleanliness, sewage and drainage, excrement and refuse disposal, water supply, and condition of dwellings. Of course, this survey was designed rather to discover faults than to observe excellencies; and, accordingly, a great many defects in the local health arrangements of the kingdom are recorded.

. . . . . .

"To discover the actual material of cholera in such a situation that it must be voided during the customary operations of the diseased body, to the danger of water and of soil that received contamination by it, would be in triumphant accord with the views prevailing among European etiologists respecting the spread of cholera among communities.

. . . . .

"Those who hold the doctrine that cholera can be so produced, do not need to be told that cholera excrements can contaminate hands of attendants and sources of drinking water without doing harm. But, admitting always that this is possible, the fact affords no ground for saying that there are not states of evacuations and conditions of contamination—conditions of places, of times and seasons—in which pollution of water by cholera excrements may be the acting cause of cholera outbreaks among communities. Of our better known enteric fever of Europe, no one would assert that it habitually spreads to nurses who have to soil their hands with its excrements, or that drinking water befouled by those excrements, needs must, under all circumstances, cause enteric fever among consumers of the water. But of enteric fever, no one, I suppose, would deny that water polluted by its excrements does, under circumstances that are not completely definable, become the cause of causes of enteric fever outbreaks among populations."

At page 110, Dr. Ballard states . . . . . "then followed, during the epidemic of 1854, the remarkable and shrewd observations of the late Dr. Snow, demonstrating incontrovertibly the connection of cholera with a consumption of specifically polluted water, startling the profession by the novelty of his doctrine, and inaugurating a new epoch of etiological investigation.

At page 113:—

"The water supply, its sufficiency in quantity, and its quality or liability to dangerous pollution, especially to excremental pollution.

At page 114:—

"It is in the smaller towns, and especially in those within rural sanitary districts, that most complaint of uncleanliness has been made, and chiefly in those towns, whether within urban or rural districts, which contain the largest proportion of a labouring population, and where sewering works had been neglected, or the removal of refuse matters had not been undertaken by the sanitary authority as part of their own proper functions. The keeping of pigs in the close yards of houses is often regarded with leniency by the sanitary authorities of small towns, and pig-nuisances are often not sought to be dealt with under appropriate bye-laws in urban districts, nor under the provisions of the Public Health Act relating to nuisances in rural districts. If it were to be asked where the uncleanliness of the surroundings of domestic premises is most remarkable, there can be but one reply, namely, that it is most remarkable in the agricultural villages in some rural districts, especially in those most distant from large centres of population, and on soils which are naturally retentive of moisture, or boggy.

. . . . . .

At page 117:—

"I think it may be said that in the direction of wholesome dealing with excrement less has been accomplished, especially in small towns and in rural villages, of recent years than in any other direction of sanitary amendment. Indeed, in some rural districts the condition of things in this respect is still most deplorable.

At page 119:—

"provided with a supply from some extraneous source. Few of the results of the survey are more gratifying than this, when it is kept in mind that the urban districts particularly referred to are principally the districts along the coast, or in closest relation with the coast, and with our ports; and when, in this connection, it is remembered that the most serious extensions of cholera have, in former years, been brought about through the agency of specifically polluted drinking water. It is specially gratifying to notice how generally external supplies have taken the place of house-wells in the colliery districts of South Wales and Durham. It is observable, too, that the supplies, where given, have usually been extended to all parts of an urban district, that the supplies are almost universally upon the "constant" system and abundant in quantity, and that concurrently with the giving of a public supply, measures have been taken to abolish such dangerous local supplies to domestic premises as shallow wells. Indeed, in very many districts, such sources as shallow wells are now non-existent; in other urban districts, where they have not been, as yet, totally abolished, a progressive abolition of them is in hand. Nor, as a rule, have the inspectors engaged upon the survey found much occasion to complain of the quality of the water, or of pollutions, or suspicion of pollution at its source, or in the course of its distribution, but there are some notable and very serious exceptions to the rule.

"The tale told by the inspectors about the rural districts is very different. The provision of a public supply to small towns and villages within the jurisdiction of rural authorities is the exception and not the rule, and even where there has been found anything deserving the name of public supply, it has been provided usually by some local proprietor for his own tenants alone, and by no effort made by the rural authority in behalf of the populations under their sanitary care. As a rule these small towns and villages, neglected often in other respects (*e.g.*, in their scavenging and drainage), are still left, as during former cholera years, to draw their domestic water supplies from shallow wells sunk in a soil sodden with soakings from privies and leaky drains, from some streams polluted either with the drainage of the place itself, or of parts higher up, and in some few places even from such filthy sources as ponds and ditches. Again I am bound to add that in many of the colliery villages in rural districts of Durham, where the mine workings are sunk through the magnesian limestone, the good water struck during the sinkings has been made available by the owners for the domestic use of their tenants, by conveying it by pipes into their villages.

It will be perceived then, from what has preceded, that the Public Health (Water) Act, 1878, which it was hoped would greatly ameliorate the condition of the rural districts of the country in this respect, and which in many parts has so ameliorated it, has frequently failed in its object. For any notice that has been taken of the Act in some of the rural districts visited during the survey, the statute might just as well not have been passed.

At page 120:—

"In some few towns with a public supply, it was observed to be the practice to flush the sewers from the water mains through a direct communication between the two. In every town where these things are done or permitted, the danger of the practice was pointed out by the inspector. For the most part, in waterclosseted towns with a public water supply, the supply to the cistern closet is given through the medium of a special flushing tank; but in some it was found that direct communication of the mains with the closet pans was permitted. These were the ordinary faults, where fault was discovered, in the method of distribution on the constant system. In the few instances of intermittent supply, the fault of using the same storage cistern for the closet and for the supply of drinking water was not unusual.* In rural districts it was not uncommon to find that the water brought from springs at a distance was unprotected in its course or some part of its course.

---

* This condition of things exists in many parts of densely populated districts of the metropolis.

"Before concluding what I have to say about water supplies, it may be well to allude to a difficulty experienced at Swansea, and which was pointed out to me by the town clerk there in connection with the outbreak of enteric fever above referred to. The waterworks and reservoirs are the property of the Urban Sanitary Authority of Swansea, but the gathering ground of the reservoir which became specifically polluted is a wide range of moorland at a distance, which moorland is dotted over with farm homesteads and cottages, the whole being out of the sanitary jurisdiction of the urban authority, and within the jurisdiction of a rural authority which has no particular interest in safe-guarding the town supply, and evidently, in this instance, took no trouble in the matter. The unwholesome condition of these farmsteads, and especially of that one which did the most mischief last year, was well known to the medical officer of Swansea, and to the urban authority, and had been so known for a long time before last year's outbreak.* Nor was last year the first year in which danger had arisen of pollution of the Swansea water from these places. It was a constant danger, and an especial danger in time of heavy rain, of which all were well aware. Yet the urban authority have been throughout powerless to obviate it, except by the purchase of the whole tract of land and the farms upon it, or by abandoning a large part of their gathering grounds and so contracting the water supply of their rapidly growing urban district. Some effectual remedy against such a state of things ought to exist."

* 1885.

At page 137, Dr. Blaxall states :—

"Subsequently, on Dr. Taylor questioning the captain as to the health of the ship during the voyage home, he learned that diarrhœa of a suspicious character broke out soon after leaving Marseilles, and continued for some days, until the captain, attributing the diarrhœa to the water he had taken on board at Marseilles, took the precaution to have it boiled before issuing it for drinking purposes, with the result that the diarrhœa ceased.

At page 139 :—

"Again in regard to the second-named danger: "*contaminated water.*" Water taken on board at an infected port is open to suspicion of *specific* contamination, and it is to be desired that the water supply of such ships should, on the ship's arrival, be made the subject of special examination, and her tanks be emptied and thoroughly cleansed.

At page 140 :—

"As emphasising the importance of this precaution the following cases possess peculiar interest :—

"During the year 1884, ten ships arrived at Liverpool from the cholera-infected port of Marseilles, three out of the ten watered at that port, and suffered during the passage home from cholera or choleraic diarrhœa, whereas the remaining seven that did not water there were exempt from the disease."

"The Board of Trade . . . . instructions (in various languages) to masters of ships as to water supplies, observing with reference to the water that the greatest care should be paid to having a supply of pure water. If the water is suspected of being impure it should be boiled before drinking, and should not be drunk later than 24 hours after such boiling."

In cases of epidemic, water carries its infective character and influence far and wide. Dr. Buchanan, the medical officer of the Board, in his report to the Local Government Board, under date of July 21st, 1885, pp. 107 and 108, makes the following recommendations. and the importance thereof can only be judged by a careful reading and consideration as to the transmission of the pestilential germs by the water used in each dwelling, even in that supplied by water companies " in enormous volumes."

"Cholera in England shows itself so little contagious, in the sense in which small pox and scarlatina are commonly called contagious, that, if reasonable care be taken where it is present, there is almost no risk that the disease will spread to persons who nurse and otherwise closely attend upon the sick. But cholera has a certain peculiar infectiveness of its own, which, *where local conditions assist*, can operate with terrible force, and at considerable distances from the sick. It is characteristic of cholera (and as much so of the slight cases where diarrhœa is the only symptom as of the disease in its more developed and alarming forms) that *all matters which the patient discharges from his stomach and bowels are, or can become, infective.* Probably, under ordinary circumstances, the patient has no power of infecting other persons except by means of these discharges; nor any power of infecting even by them except in so far as particles of them are enabled to taint the food, WATER, or air, which people consume.

"In order rightly to appreciate what these facilities must be, the following considerations have to be borne in mind:—*first*, that any choleraic discharge, cast without previous thorough disinfection into any cesspool or drain, or other depository or conduit of filth, has a faculty of infecting the excremental matters with which it there mingles, and probably, more or less, the effluvia which those matters evolve; *secondly,* that the infective power of choleraic discharges attaches to whatever bedding, clothing, towels, and like things, have been imbued with them, and renders these things, if not thoroughly disinfected, as capable of spreading the disease in places to which they are sent (for washing or other purposes) as, in like circumstances, the patient himself would be; *thirdly*, that if, by leakage or soakage from cesspools or drains, or through reckless casting out of slops and washwater, any taint (however small) of the infective material gets access to WELLS OR OTHER SOURCES OF DRINKING WATER, it imparts to enormous VOLUMES OF WATER THE POWER OF PROPAGATING THE DISEASE. When due regard is had to these possibilities of indirect infection, there will be no difficulty in understanding that even a single case of cholera, perhaps of the slightest degree, and perhaps quite unsuspected in its neighbourhood, may, *if local circumstances co-operate*, exert a terribly infective power on considerable masses of population.

"The dangers which have to be guarded against as favouring the spread of cholera-infection are, particularly, two. First, and above all, there is the danger of WATER-SUPPLIES which are in any (even the slightest) degree tainted by house refuse or other like kinds of filth; as where there is outflow, leakage, or filtration, from sewers, house-drains, privies, cesspools, foul ditches, or the like, into SPRINGS, STREAMS, WELLS, or RESERVOIRS from which the supply of WATER is drawn, or into the soil in which the WELLS are situate; a danger which may exist on a small scale (but, perhaps, often repeated in the same district) at the PUMP or DIP-WELL of a PRIVATE HOUSE, or, on a large or even vast scale, in the source of PUBLIC WATERWORKS.

"Information as to the high degree in which those two dangers affect the public health in ordinary times, and as to the special importance which attaches to them at times when any diarrhœal infection is likely to be introduced, has now for so many years been before the public, that the improved systems of refuse-removal and WATER-SUPPLY by which those dangers are permanently obviated for large populations, and also the minor structural improvements by which separate households are secured against them, ought long ago to have come into universal use.

"So far, however, as this wiser course has not been adopted in any sanitary district, security must, as far as practicable, be sought in measures of a temporary and palliative kind.

"Immediate and searching examination of sources of water supply should be made in all cases where the source is in any degree open to the suspicion of impurity; and the water both from private and public sources should be examined. Where pollution is discovered, everything practicable should be done to prevent the pollution from continuing, or, if this object cannot be obtained, to prevent the WATER from being drunk. CISTERNS should be cleaned, and any connexions of waste-pipes with drains should be severed."

Report of the Royal Commission, 1868-74.

At page 141 is this important allusion to the transmission of disease:—

"In like manner, it is a fact that

Scarlatina,
Diphtheria,
Measles, and
Typhus fever

can be transmitted from diseased to healthy persons, not only without contact, but also without any apparent communication, the poisonous matters in these cases being presumably conveyed through the air from person to person. In the communication of these diseases, however, the conclusiveness of the fact is somewhat disturbed by the circumstance that a considerable per-centage of failures in the transference of the disease is observed, even when the persons who remain uninfected, are exposed to infection under apparently precisely the same conditions as those to whom the disease is communicated. "Again, it is a fact that cholera and typhoid or enteric fever can be communicated from individual to individual; and the infectious matter of these diseases, which resides in the discharges from the stomach and bowels of the patients, is believed to be occasionally conveyed by air, but a great mass of experience renders its propagation through the medium of drinking water almost certain.

"At page 23 numbered 10 and 11 it is there stated, that "Slow filtration through sand is almost always effective for the removal of visible suspended matters, but the washings of clay soils are very difficult to render bright by sand filtration; and in all cases filtered water, if turbid previous to filtration, is always seen by suitable optical means, to be full of minute suspended particles, although to unassisted vision it is perfectly clear and transparent.

"The organic matters in suspension in potable water possess not only all the objectionable qualities of similar matters of mineral origin, but in addition they are sometimes actively injurious, and they always promote the development of crowds of animalculæ.

. . . Their presence in drinking water is therefore much more objectionable than is the occurrence of mineral matters in suspension. Like the suspended mineral matters, the finely divided organic matters in suspension cannot be entirely removed by sand filtration."

"Impure Water."*

At page 163, it is stated that "Typhoid fever is endemic in this country, and slays on the average, in England and Wales alone, about 15,000 persons annually out of a population of 22,712,000 . . . In a great majority of cases . . . water polluted by sewage, if not by typhoid sewage, had been consumed by the individuals attacked.

At page 17, it is asserted that "It follows from what has been already stated that chemical analysis cannot discover the noxious ingredient or ingredients in water polluted by infected sewage or animal excreta; and as it cannot thus distinguish between infected and non-infected sewage, the only perfectly safe course is to avoid altogether the use, for domestic purposes, of water which has been polluted with excrementitious matters.

"Nevertheless, as it is very difficult in some localities to obtain water, which has not been more or less polluted by excrementitious matters, it is desirable to classify such previously contaminated drinking waters into :—

---

* The Royal Commissioners used this title.

Reasonably safe water.
Suspicious or doubtful water.
Dangerous water.

At pages 29 and 30, it is clearly demonstrated by analysis of rain water, " even when collected at a distance of twenty-five miles from large towns, that rain water is " not free from impurities . . . samples of stored rain water from the roofs of buildings for domestic purposes in tanks contain a larger amount of impurity." . . . " Indeed five out of eight," " very badly polluted, . . .

At page 140, division II, the most profound researches have established the " fact, that—

Cow-pox,
Sheep-pox,
Small-pox,
Hydrophobia,
Glanders,
and Syphilis,

as reported by Mons. Chauveau to the " Academie des Sciences," Paris, " can be, with a very small percentage of failures, propagated from individual to individual by means of an excessively small amount of organic matter.

At page 255 is the following:—

"The *Thames* and *Lea* are . . on their way to the intakes of the water companies . . . . largely contaminated by sewage, and the drainage from fields dressed with animal manure, and this especially in the winter months.

Floods at spring tides, assisted by strong winds, and at other periods, between October and March, caused by heavy rainfalls where the land is generally in a swampy condition, the pollution of all rivers and their tributaries cannot be otherwise than injurious to the character of the water supplied to all dwellings, notwithstanding filtration through "sand."

"As to the Quality of the London Water Supply which is derived from the Thames.

"The *Thames* above the intake of the respective water companies, receive the sewage from a large number of towns and other inhabited places, the washings of a large area of highly cultivated land, and the filthy discharges from many industrial processes and manufactures.

"The river is used for bathing, for the washing of sheep and cattle, and of dirty linen; and the putrid carcases of animals float upon its surface. It is the common water way for a large amount of polluting matter, much of which is at times dangerous to the health of persons who use even the filtered water for dietetic purposes.

"In time of flood, a large proportion, both of the suspended and dissolved filth, is conveyed down to the intake of the metropolitan water companies; and in ordinary weather a considerable proportion of the soluble organic matter of sewage, discharged into the river and its tributaries, likewise makes its way down to the works of the water companies, and is still present in the water distributed by them in London.

. . . . . .

"Notwithstanding the application of partial remedies for sewage pollution at Banbury, Eton and Windsor, and the greater care exercised by most of the companies in the storage and filtration of the water, the organic pollution contained in the *Thames* water delivered in London, though subject to fluctuation from the greater or less prevalence of floods, does not diminish.

"There is no hope of this disgusting state of the river being so far remedied, as to prevent the admixture of animal and other offensive matters with the filtered *Thames* water as delivered in the metropolis."

The following, extracted from the Report of 1875, on the waters from the remaining surface wells and pumps in the City of London, by W. Sedgwick

Saunders, Esq., M.D., F.S.A., President of Hunterian Society, Medical Officer of Health and Public Analyst for the City of London, is of great value, as being applicable to similar waters in all parts of the United Kingdom of Great Britain and Ireland :—

" Great ignorance exists in quarters where these pumps are in daily use, and much obstruction is met with from persons who argue, that because these waters are *bright*, *cool*, and *sparkling*, and because they have been unable to trace the mischief done to those who drink the same upon the faith of these appearances, that, therefore, they must, of necessity, be harmless.

" Such people ignore the teachings of science, and despise the warnings of competent authorities, who have again and again informed them that the very qualities which have made the waters popular are produced by the presence of the products of decomposing nitrogenous matter of the most revolting kind, coming, as they do, in most cases from the graveyards in their immediate neighbourhood.

" Under these circumstances, I trust I may be deemed justified in travelling a little beyond the scope of an ordinary report, and enter briefly upon a description of the scientific value of the different ingredients in the waters in common use, and draw the distinctions between their normal and abnormal constituents.

"In analysing water for sanitary purposes it is essential to determine the following:—

i.—The amount of total solids;
ii.—The amount of chlorine;
iii.—The amount of free ammonia;
iv.—The amount of albuminoid ammonia.

"The solids.—These consist of carbonate of lime, and chlorides (in the form of common salt), both of which are harmless unless very excessive; of sulphate of lime; sulphate and carbonate of magnesia (which are objectionable as making the water medicinal); of silica (about one-half of a grain to one grain per gallon in most waters); of traces of potash salts; of metals (iron and alumina), and phosphates (more than a trace of which is incompatible with a water containing any carbonate of lime); also of nitrates (which are produced by the oxidation of nitrogenous organic matter, and may be combined with any base that happens to be present, *i.e.*, potash), &c."

Report of the Royal Commission, 1868-74.

At page 285:—

"The temperature of the water drawn from the companies' mains is liable to excessive fluctuations, being near the freezing point in winter, and so high in summer as to render the water vapid and unpalatable.

"We, therefore, recommend that the *Thames* should, as early as possible, be abandoned as a source of water for domestic use, and that the sanction of

Your Majesty's Government be, in future, withheld from all schemes involving the expenditure of more capital for the supply of *Thames* water to London.

"As to the Quality of the Water supplied to London from the Lea.

"The pollution of the *Lea* above the intake of the water companies, is similar in character to that of the *Thames* but considerably less intense.

"Sewage and other disgusting matters reach the intake of the metropolitan water companies drawing from this river, and the soluble portions of such matters are not wholly eliminated by the efficient filtration to which the water is subjected before delivery.

"The water of the *Lea* is slowly, though irregularly deteriorating from year to year, and there is no hope of purifying it to such an extent as to render it, at all times, safe for domestic use.

"We, therefore, recommend that the *Lea* should also be abandoned as a source of potable water. This measure is less urgent than the relinquishment of *Thames* water, but the sanction of Your Majesty's Government ought not, in our opinion, to be accorded to any further expenditure of capital upon the supply of *Lea* water to the metropolis.

"Nothing would be gained by the abstraction of the water at any higher points, short of the springs forming the sources of the tributaries of these rivers.

"As to the Water Supplies of other British Cities, Towns, and Inhabited Places.

"In other towns, and in villages and other inhabited places, the water available for domestic purposes is frequently neither abundant nor wholesome. In these cases, it is a widely spread custom to drink, either the water of rivers into which the excrements of man are discharged, or the water from shallow wells which are largely fed by soakage from middens, sewers and cesspools.

"Immense numbers of the population are thus daily exposed to the risk of infection from typhoidal discharges, and periodically, to that from cholera dejections.

"The supply of villages and hamlets with wholesome water is often a problem of great difficulty, since the number of inhabitants is too small to permit of the execution of expensive works for such an object. We, therefore, recommend that in any scheme for the utilization for town supply, of the pure water of a river basin, the wants of all neighbouring villages and hamlets should be provided for as far as practicable; and we further recommend that the owners of land should be permitted to include the cost of village water supply among those expenditures on land improvement which they are now enabled, with the sanction of Your Majesty's Inclosure Commissioners, to charge upon their estates.

" Whenever the necessities of the case compel the supply of water to a town from a river or stream into which the excrements of man, whether purified or not, are discharged, we recommend that storage reservoirs should be provided of sufficient capacity to render unnecessary the abstraction of water from such rivers or streams during floods. These storage reservoirs ought to be so constructed and worked as to allow of the discharge of their contents into the river or stream, whenever the quality of the latter becomes superior to that of the previously impounded water.*

"As to the possibility of rendering Polluted Water again Wholesome.

" Of all the processes which have been proposed for the purification of sewage, or of water polluted by excrementitious matters, there is not one which is sufficiently effective to warrant the use, for dietetic purposes, of water which has been so contaminated. In our opinion, therefore, rivers which have received sewage, even if that sewage has been purified before its discharge, are not safe sources of potable water.

* This costly storage, under Professor Clark's process and The "Atkins" system, is not now necessary.

"As to the Propagation of Epidemic Diseases by Potable Water.

"The existence of specific poisons, capable of producing cholera and typhoid fever is attested by evidence so abundant and strong as to be practically irresistible. These poisons are contained in the discharges from the bowels of persons suffering from these diseases.

"The admixture of even a small quantity of these infected discharges, with a large volume of drinking water, is sufficient for the propagation of those diseases amongst persons using such water.

"The most efficient artificial filtration leaves in water much invisible matter *in suspension*, and constitutes no effective safeguard against the propagation of these epidemics by polluted water. Boiling the infected water for half an hour is a probable means of destroying its power of communicating these diseases.

"Other epidemics, such as dysentry and diarrhœa, are also probably propagated by drinking water, but the evidence is here neither so abundant nor conclusive as it is in the case of cholera and typhoid fever.

Brighton Health Congress, 1881.

THE SEED TIME OF HEALTH.

By the President, BENJAMIN WARD RICHARDSON, M.D., LL.D., F.R.S.

. . . . . . "come back to the first-fruits of the earth for food; drink no impure drink; wear no impure clothing; do no impure act; and all the good that science can render you is at your absolute command.

You are already a school-ground of schools; let that be your abiding tradition, and let your town, in which the ideal of a model city was announced, be the model Hygeiopolis itself—the common-health of the Commonwealth."

ADDRESS

By EDWIN CHADWICK, C.B., President of Section A.

" I asked a relieving officer of a large district—to test his knowledge of the habitat of such disease—whether, if I gave him some half-dozen cabs, he knew where, without previous knowledge, he could go and fill them to bring fever cases, and he said he could, just as a gamekeeper might go and get a bag of game—he said he certainly could; the cases might not be all of typhus, but fever cases of one sort or another: he knew where he could find them."

ADDRESS

By Alfred Carpenter, M.D., C S.S , President of Section C. (of Croydon.)

"As a consequence of this indifference, the ignorant opponent of sanitary work, or the hidden participator in some parish job, or the promoters of some commercial undertaking—said to be sanitary, but which is usually the contrary—is placed at the head of the poll, to the serious detriment of good sanitary work.

" A series of meetings in different great towns like to these which are being held this week in Brighton, will assist to checkmate such results by enlarging the mental calibre of the British ratepayer who elects our common councils and our local boards, and will thus diminish the chances of his being made the tool of designing knaves, or the supporter of self-satisfied ignorance.

" I believe every person is entitled to live to that age,* and if he does not he is deprived of a portion of his birthright, either by his own act or by the acts of other persons. There is a time when a man must go down to the grave, but it ought not to be in consequence of disease, and it ought not to be before he has passed at least 90 years on earth. Death will come though disease need not, and death without disease would probably be no more pain to men than the fact of being born into this world is to the child. Uneasiness there may be, but not that acute suffering which arises in most instances from a disobedience to God's laws, either on the part of the individual himself, or of the commonwealth to which he belongs, or to his predecessors, or forbears upon the earth.

---

* 100 years.

"Let the destructive effects of foul air upon the employés at the Government offices, and the death of Dean Stanley, answer this suggestion; let the *Times* newspaper be consulted any day in the week, and you will find in the obituary a record of someone who has been cut off by active disease, the consequence of impurity in the house, which impurity is at present scarcely suspected to have been the cause of that particular person's death. It is hidden in the neighbourhood of the house, and is possibly unknown. Erysipelas, or carbuncle, or so-called inflammation of some particular organ, has cut off the victim in the prime of life, and the death is at present seldom referred to its real cause, viz., foul air in the house, and which probably comes from the drain.

"There is scarcely a house in the kingdom in which excreta are not to some extent retained. The most civilized and luxurious home is, in some cases, carefully prepared for the cultivation of factors of disease, if they come into our midst: carpets, curtains, and comforts of all kinds retain the debris from our skins and our pulmonary membranes; the excreta from our sweat glands are allowed to settle upon our uncleaned windows, on out-of-the-way cornices, useless ledges, and so-called architectural or upholstering ornaments; and our smoking friends spit about in a fashion which allows of forcing beds for disease germs to exists everywhere, so that but for enforced ventilation, even the smoking carriages on our railroads would be very pest houses if disease germs find admission to their floors, while our sensitiveness to draughts, and the way in which we heat our dining-rooms and offices, our public places of resort, our churches and drawing-rooms, provides a forcing-house for the growth of disease which it seems almost impossible to disperse. I say almost impossible, for this is only as regards present time; with the growth of knowledge there will be a gradual removal of causes, and when the wholesale distribution of disease germs by water companies, or by other impure sources of supply, by impure food, and by sewers, is absolutely stopped, the private multiplication and spread of factors will be capable of being stamped out in a far easier and more satisfactory way than is now the case. Pure air, pure water, pure food, and temperate habits will diminish the amount of pabulum in which disease factors can develop, and with those benefits we shall have a diminishing amount of impurity in the blood of individuals, which will gradually be effected in consequence of a more perfect knowledge of public hygiene."

HINTS ON DOMESTIC SANITATION.

By Henry F. Strong, M.D. (of Croydon).

"It is only within the latter part of the present century that public attention has been directed to questions of sanitation, till Sir Wm. Jenner, and, subsequently, the late Dr. Murchison, pointed out the difference between them both as to their origin and symptoms. Typhoid and typhus fevers were presumed to be one and the same disease, and it is but a few years ago that it was demonstrated by Drs. Buchanan, Simon, and others, that the germs of typhoid were communicable through the agencies of milk and of impure water.

"It will be sufficient for us to know that it is an important excretory and absorbing organ, that by it a large amount of aqueous fluid containing certain elements in solution are eliminated from the body by the sudoriforous, or sweat glands, the average number of pores in each square inch throughout the body being about 2,800, and it materially assists the kidneys and lungs by the excretion of urea in the one case and carbonic acid gas in the other. In addition to its power of increasing the deterialization of the blood, it will thus easily be understood that there is a vital necessity for keeping the surface of the skin clean by the daily use of a sponge bath or frequent ablutions, especially with soap, to get rid of the fatty constituents of the perspiration.

"Mr. Simon, late Medical Officer to the Privy Council:—"It is to cleanliness, ventilation, and drainage, and the use of perfectly pure drinking water, that the population ought mainly to look for safety against nuisance and infection;" and, in the words of another writer, "No better Christian work can be done than the propagation of such knowledge as will carry a firm conviction to the minds of the people at large, and give them such warnings and instructions as may secure the mitigation, if not the extinction, of infectious diseases."

ON THE PROPAGATION OF DISEASE THROUGH FOOD AND DRINK.

By R. P. Taaffe, M.D., &c., Medical Officer of Health for Brighton.

"There is a very fatal disease called hydatids, generally found attacking the liver or lungs of the human subject, which is acquired by swallowing the ova or eggs of tape-worm, called *tœnia echinococcus.*

"Man may become infested by these parasites, either by taking them with food containing the cysticerci, or through drinking water which holds the ova of the worm, or through milk which has been adulterated with impure water which has the ova.

"From instances observed it appears that scarlet fever, when conveyed by means of milk or other drink (for there is no reason to suppose but that if milk can be a medium, so can water, or any other fluid) the incubation stage is much shorter than when the atmosphere is the medium.

"Not only the tape-worm, but other forms of entozoa or worms are propagated through the media of food and drink; but in the latter case it is due to the direct introduction of their ova or eggs into the human alimentary canal : it can happen from swallowing the ova with vegetables, or in water, or in milk adulterated with water.

"Dr. Ballard, of the Local Government Board, was, I think, the first who called attention to the infection of milk. This occured in an outbreak at Islington, in 1870, when it was ascertained that the cans were rinsed out with water polluted by typhoid matter. Again, in the celebrated Marylebone epidemic, the cause was clearly traced to the farm where the water used for rinsing the cans was polluted with typhoid sewage. In an epidemic investigated by Dr. Airey, of the Local Government Board, it was ascertained that the milkman washed the udders of the cows with water from a stream into which typhoid sewage found its way, and that a minute portion of the water from the stream had become mixed with the milk. Dr. Ernest Hart, at the International Medical Congress, gave particulars of 71 recent epidemics due to infected milk, that have been recognised, and made the subject of detailed observation in this country, 67 of them since the Marylebone milk typhoid epidemic traced by Dr. Murchison and himself in 1873 ; the number recorded of epidemics of typhoid as due to milk is 50 ; scarlet fever, 14 ; diphtheria, 7, ... but no one has even hinted at suspecting beer.*

"Why may not the barman or barmaid who draws the beer have been in the desquamating stage of scarlet fever, or why may not scarlet fever or typhoid fever be existing in the public house or beershop? Up to the present time no outbreak of these diseases has been traced to beer; Bacteria have been shown to exist in beer, but as a crum of comfort to beer drinkers, it is said that alcohol and the bitter of the hop are poisons to the organisms, and doubtless it may be owing to this that highly fermented beer and bitter ales can be kept for a long time and improve by keeping, bitter beer, for instance, that has been to India and back; but what is to prevent the low class beers from being adulterated, purposely or accidently, with polluted water just as in the case of milk. I am told that whenever beer is doctored (I object most strongly to the term) the water which is added is boiled; but polluted water which has not been previously boiled, is just as likely to find its way dishonestly into beer,* or by rinsing the cans, &c., as in the case of milk, and a person may be down with scarlet fever or typhoid fever as well in the beershop as at the dairy; but I think that, as a rule, cans and pots in public houses are wiped dry, which gives security."

---

* The Corporation of Burton-on-Trent has, by the offer of £4,000, endeavoured to compromise with Messrs. Bass & Co. their claim of £8,000 for the pollution of their Wells by the refuse of the Gas Works.—*Daily Press.*

SERMON

Preached in the Dome, Royal Pavilion, Dec. 18th, 1881, by the Mayor's Chaplain, the Rev. John Julius Hannah, M.A., Vicar of St. Nicholas, Brighton.

"Some of you will remember the fearful visitation of Asiatic cholera which attacked these islands some five and twenty years ago. The devastations caused by that dire disease were, no doubt, due, in a very great degree, to the neglect and carelessness in which we were then living. The reasons which made the scourge so terrible, doubtless, were such things as bad food, bad air, crowded bedrooms, the filth of our great cities left to ferment in poisonous cesspools, foul ditches, and marshes, and mud, and such things as these. When the plague was at his height, some called it a visitation or judgment of God. And as things got worse, the Prime Minister of the day, the late Lord Palmerston, was asked to appoint a National Fast Day, in the hope that thus the evil might, by the direct interposition of the Almighty, be alleviated or removed. He refused the request, and told people instead to turn to the work of sanitary reform, to whitewash their houses, and clear away their filth. This refusal was naturally much commented upon at the time, and many were those who condemned it as irreligious, as flying in the face of Providence, and the like. And no doubt the necessity for the one thing was no argument against the other. The Fast Day would not have impeded the cleansing, any more than the cleansing need have been considered sufficien. without the fast. But there was not wanting at least one clergyman—the late Charles Kingsley— to come forward, and go so far as even publicly to thank him in these words: "As a clergyman, I feel bound to express my gratitude to Lord Palmerston for having refused to allow a National Fast Day on the occasion of the present reapperance of pestilence, and so having prevented fresh scandal to Christianity, fresh excuses for the selfishness, laziness, and ignorance which produce pestilence, fresh turning men's minds away from the real causes of this present judgment, to fanciful and superstitious ones. It was to be hoped that, after the late discoveries of sanitary science, the clergy of all denominations would have felt it a sacred duty to go forth on a crusade against filth, and so to save the lives of thousands, not merely during the presence of cholera, but every year." There is much truth in these burning words, which the Church has come at last to recognise."

---

* The Revenue Department makes frequent discoveries of adulteration of beer by water and other ingredients.

Dr. Bernays reports to the Camberwell Vestry:—Beer "brewed with London water" giving "over fifty grains of chloride of potassium and sodium, . . . these do not come from malt and hops."

"Daily News," October 9th, 1886.

THE CHOLERA.

"A Supplement, containing Reports and Papers on Cholera, submitted by the Medical Officer of the Local Government Board, has just been issued in connection with the Fifteenth Annual Report of that Department. This bulky volume, in addition to the Report of Dr. BUCHANAN, contains a voluminous Appendix.

In his Report on Cholera in Europe, Dr. THORNE THORNE incidentally repeats the great lesson which foreign nations, it would appear, have yet to be taught—namely, that it is to filthy surroundings and to the want of care in ensuring a pure water supply that the repeated attacks and continuance of cholera are due. Dr. BUCHANAN himself reiterates this wholesome teaching. His words are worth remembering. "The views of England concerning cholera in Europe," says the Medical Officer of the Local Government Board, "obtained from her own experience, and strengthened by what she can learn of other countries, are that for European communities which have secured their soil, water and air against befoulment, there is little or no danger of cholera, no matter though the disease be actually brought into their midst." These are notable words, and they teach us the immense advantage we gain in the matter of freedom from a terrible disease by attention to what are really only the plain details of simple cleanliness. "Communities," continues Dr. BUCHANAN, "which have not obtained this result, have to encounter an unknown and serious measure of risk from cholera when it chances to be encountered among them." He urges that England puts her trust in measures which will secure purity of air, earth and water. This is really all that is needed to avert cholera epidemics; but it is precisely such conditions of cleanliness that are wanting in continental regions.

As matters stand, Dr. BUCHANAN declares we are to-day "in the same position as before, of ignorance as to what may be the relation of cholera to bacterial, or germ, life." This conclusion, it will be noted, by no means excludes the possibility, or indeed the probability, that cholera is a germ-produced disease. It really stands in the same position as small-pox or scarlet fever. We do not know the germs which produce these ailments, although we may not doubt that they owe their existence and propagation to these living particles. It is only a question of waiting for light to be thrown on the whole matter. Even if Koch's views are unacceptable, that is no reason why the future should not demonstrate the real facts of the case. Dr. Snow, in 1849, was very forcible in his declaration that to water polluted by cholera and typhoid excretions we owe the continuance and dissemination of these diseases.* Dr. Buchanan would have us remember that Snow's conclusion remains sound and unopposed at the present time, and this although we are as yet unable to point to the exact nature of the cause or material to which the pollution of water-supply is due."

"Daily Chronicle," October 16th, 1886.

"Under the head of Public Health, the Local Government Board, in its report, deals with a vast variety of subjects—Loans, Drainage, Pollution of Rivers, Artisans' Dwellings, Adulteration of Food, Vaccination, Water Supply and the like. Here the portion of the report that is most interesting to us is that which touches the River Lea. It appears that complaints as to the foul condition of that stream are still rife. Yet the Local Government Board seem to be continually sanctioning small local loans which are raised for the purpose of purifying it. In 1883-4 a loan of £13,360 was sanctioned for large extensions of the outfall sewage works at Tottenham. These works were manifestly inadequate for the immediate object in view, and the Local Government Board accordingly advised the local board to consider whether it would be possible to purify the sewage of Tottenham chemically before its effluent stream was discharged into the river. The local board undertook the work after they were allowed to raise a small loan. Yet no great good seems to have resulted from their efforts. Mr. Arnold Taylor, one of the Local Government Board inspectors, in September, 1885, reported that the Lea was in a very foul state indeed, though some slight improvement has taken place in it since then. With regard to the housing of the poor, the report of the Local Government Board seems a trifle thin and technical—indeed, it is not till we come to the passages dealing with canal boats that a patch of picturesque colour gleams on the discussion. The Sanitary Acts regulating the management of these craft have been fairly well enforced by the authorities, who for the most part rise to the level of their responsibilities. This administrative activity has manifestly resulted in raising the standard of civilisation among the nomadic population of the canals. Yet the difficulty of working the Acts is very great. Tact and discrimination are eminently useful in an inspector who does his duty faithfully. A barge is a moving house, and in a single voyage it may pass through many districts. If stopped and overhauled by the local authorities at each of these districts one after the other, barge traffic will be greatly impeded. But the trouble is to see a way out of this difficulty. If it is known that the inspection of strange barges is only to take place in a particular district, why obviously an overcrowded boat will drop some of its passengers before it reaches this district, to rejoin the Royal party afterwards. Canal boats, we are sorry to see, are defective in sleeping accommodation, and their ventilation is extremely bad. Then, again, the bargee and his family are poorly supplied with wholesome water. He is, in truth, like Coleridge's "Ancient Mariner"—"water, water everywhere, but not a drop to drink." As for the water from the canals which the bargee's family too often used it is extremely foul. In fact, it may be defined as a more or less dilute solution of sewage, and the puzzle is how one survives after drinking it. Perhaps this has something to do with the extraordinary heavy mortality noticeable among bargemen, who ought from their free open-air life to be a remarkably long-lived race. As matters stand the death-rate among bargees and lightermen is twice as high as it is among agricultural labourers. It may, however, be that bad beer as well as bad water helps to shorten the average bargee's life."

---

* Pages 150, 151, of Report of Royal Commission on Rivers' Pollutions, 1868-74.

"Daily Chronicle," October 18th, 1886.

THE POLLUTION OF THE RIVER LEA.

"Dr. J. W. Tripe, the medical officer of health for the Hackney District, has prepared a special report on the present condition of the River Lea, as the result of impurity. He visited the river several times and found "that the river now contains a large proportion of sewage near Tottenham, but it is not so bad in the Hackney district. About 50 yards from the Tottenham outfall there is as much ammonia and organic matter in it as equals one-third of sewage and two-thirds of distilled water. On Monday the effluent contained as much ammonia and organic matter as sewage taken from the sewer in Mare Street, and smelt worse. The short time the new sewer has been used this year was insufficient to allow the river to obtain a good state before the effluent was poured in again on Oct. 1st, but I am much disappointed with the present state of the river as compared with what I obtained at the end of last September." Dr. Tripe's recommendation, that the Lea Conservancy Board should be informed of this, and that the attention of the Tottenham Local Board of Health should be called to the insufficiency of their disinfection, is to be carried out without delay, at the instance of the Hackney District Board of Health, to whom the above report has been submitted."

"Morning Post," October 6th, 1886.

A PLAGUE OF EELS IN THE EAST-END.

"The inhabitants of the East-end of London are now suffering from a plague of eels. Everybody knows that the monthly reports of the chemists employed by the water companies show conclusively that the water is absolutely free from living organisms; and the explanation seems to be that the organisms are to large to get into the microscopes. The fish which the East London Company are distributing to their customers are indeed easily visible to the naked eye, for some have been found no less than 18 in. long; and the mains abound with them to such an extent that the Local Board of West Ham has complained to the Local Government Department with the view of having some remedy applied. Eels are, it is true, a toothsome dainty, whether spatchcocked, stewed, fried, or in the form known to diners at Greenwich as *anguilles à la Toulouse*, but those in East London, instead of fulfilling their destiny by being legitimately caught, skinned, and cooked, have a fashion of committing suicide in stop-cocks and taps. There they decompose, with the result, as illustrated lately, of causing the water to become horribly putrid, and of giving something very like typhoid fever to the unlucky consumers. A whole family has just been laid prostrate in this way, and one or two of its members are still seriously ill. The company have been appealed to with little result. They say that three years ago some of their filter-beds burst, and that the unfiltered water on that occasion made its way into the mains, carrying with it a number of minute eels and other fish, which have since spawned and multiplied in the pipes. The mains have been repeatedly flushed with the object of getting rid of the intruders, but without success, and the company's engineer is only able to tell the Sanitary Authority that he does not consider that the water is injured by the eels as long as they are alive, though he admits that a dangerous nuisance may arise from them when dead. He vaguely promises that the utmost endeavours shall be used to banish them, but it is not very clear what direction these endeavours are to take. The obvious way would be to turn the water off, but it is very probable that the inhabitants of East London would suffer even more than the eels from this course. The matter is really a very serious one, for the evil is steadily on the increase. There is one consideration, too, which does not seem to have occurred either to the Local Board or to the company, and that is, whether water that can, under the conditions of its distribution here, support the life of fish, is fit for human consumption. On what do the eels feed? Clearly not on weeds or other vegetable substances, for the water is confined in iron mains. If, however, they find enough animalculæ in the water to enable them to live and grow to a considerable size, is it certain that what is eel's food may not be man's poison; and how is it that the official analysts and microscopists are periodically certifying that the water is free from any impurity of the kind? The problem requires skill and experience for its solution, and it might be worth the attention of Sir Francis Bolton, who, we believe, is the Government examiner of water."

"Echo," October 7th, 1886.

AT THE HALF-YEARLY MEETING OF THE EAST LONDON WATERWORKS COMPANY.

EELS IN THE PIPES.

Mr. Bryan, the company's engineer, said it was true that at a house in Warton Road, Stratford, the water tap did kill a very fine eel, which had managed to get into the communication-pipe. He had had the pipe taken out, and sawn through to see if it was in a state of contamination, and he had found it perfectly clean. During the last fortnight there had been seven cases only of pipes having been stopped by eels, and seven cases in a population of 1,170,000 did not indicate that the whole of the company's mains were swarming with fish, as the article in the *Morning Post* had hinted. They thoroughly scoured their mains, and this was done at night, when the pressure was greatest, so that they could blow out any eels if any happened to be in the pipes. They had done this for years past, and for weeks together they had not seen a trace of an eel. With regard to the filter beds it was utterly impossible for anything to pass through them in the shape of the smallest fish. The original filter beds, made between thirty and forty years ago, had all been improved and reconstructed, so that nothing but water could pass through them. He might add that he lived but a short distance from the house in question, and that he had seen nothing of eels. He and his family were water drinkers, and they were all in perfect health.

"Daily Chronicle," October 12th, 1886.

Sir,—In the account of the meeting of the East London Waterworks Company, which appeared in your paper of to-day, I notice that nothing was said of the very deficient water supply to this district. I am paying extra for high pressure, bath, &c., yet during at least two months of the past summer there was never sufficient water in the cistern to fill the bath; as a rule it was empty by eleven o'clock a.m., and on two occasions no water came in for three successive days. Complaints like this are general, but no notice is taken of them, although the same thing has occurred in previous years and will probably continue in an exaggerated form in the future, as the population is rapidly increasing and no attempt is being made to provide an increased supply of water.

I remain, yours &c., J. W. S.

Forest Gate, *October 8th*, 1886.

"Daily Telegraph," October 11th, 1886.

EELS IN LONDON WATER MAINS.

SERIOUS DANGER TO HEALTH.

"SIR,—May I ask the favour of insertion in your next issue of the accompanying letters on the above subject, one from our Medical Officer of Health, the other from your obedient servant,

WM. HORN,
Chief Sanitary Inspector,
West Ham Local Board.

SANITARY DEPARTMENT,
TOWN HALL, STRATFORD.
October 9th, 1886.

"SIR,—My attention has been directed to a statement in your issue of the 7th inst., and to a report of certain statements made at a half-yearly meeting of the East London Waterworks Company, held on the same day, and reported in your issue of yesterday, in reference to the above subject.

"As there appears an evident desire on the part of the company and its officers to gloss over and disguise the real nature of the peril attending the present state of the water supply, and the subject being one of prime importance as affecting the public health, perhaps you will permit me, as the sanitary officer who first called the attention of the company's engineer to the matter, to state the facts of the case as briefly as I can. Over two years ago, in September, 1884, I wrote to Mr. BRYAN, informing him of several eels of considerable size being found in the mains and branches of the company's service, one being 18 inches long; and that a serious case of typhoid fever had occurred in a house in Paul Street, Stratford, where, in consequence of a complete stoppage of the water supply the branch pipe had been cut and a putrid eel found completely blocking up the pipe. Mr. BRYAN very courteously replied, saying, "We have been troubled very considerably for the last three summers in the way mentioned in your letter." He further explained that the mischief arose from the giving way of the company's filter beds at Lea Bridge three years before, and letting the fish into the pure water basin beneath. In conclusion, after expressing an opinion that the water would not be injured whilst the fish were alive, he said, "but of course, if they die in the pipes they must contaminate the water; however, we shall use the utmost endeavours to free the whole of our mains from them as speedily as possible." I reported the whole matter to my Board, and relying on the above assurance, no further steps were taken at that time. Since then, however, the eels appear to have increased, and have been found all over this large district, from Bow Bridge to Silvertown, from the Thames to the boundary at Leyton. Numerous complaints have reached me from time to time, and on the 17th and 31st July this year I wrote to the secretary of the company informing him of the presence of dead fish in the pipes at Tucker Street, Canning Town, and that of several samples of water taken on the 29th direct from the main the water was stinking, and, on examination by the medical officer, found to contain organic matter to a serious extent, rendering it quite unfit for drinking purposes, and urging that immediate steps should be taken to remedy the evil. To this an answer dated August 6th was received from the secretary, of such a flippant and unsatisfactory character that my Board resolved to send complete copies of the correspondence to the Local Government Board, together with a statement of facts, showing that eels, dead and alive, had recently been found in various parts of this district; also that on the afternoon of the day on which the above samples were taken a dead putrid eel, about 2 feet long and nearly as thick as a man's wrist, was forced out of the main in Tucker Street when the plug was taken out by the water company's men.

"Several cases of putrid eels foundin branch supply pipes in Stratford have occured more recently, notably that at Wharton Road, the case specially referred to in the report of the water company's meeting. In refercnce to this case Mr. Bryan, the engineer, is reported to have said, "Mr. Plastow's house was built on the edge of a wide open sewer," and also that "it was ascertained in his presence that the drain or sink in the kitchen communicated with a foul open sewer." Although desirous of avoiding language likely to give offence, I am in duty bound to say that each of these statements is as far from the truth as it is possible to be. That which he calls "a wide open sewer" is a tidal ditch with no sewage whatever in it, and the sink pipe in the kitchen does not, nor did it then "communicate with a foul open sewer," but discharges outside of the house into the open air over a cleanly kept and properly trapped gully after the fashion most approved by sanitary experts of the present day. The character of the water supplied to the houses in Wharton Road prior to taking the putrid eel out of the branch pipe will be seen by the following extracts from a report made by the public analyst for the county of Essex and borough of Maldon after analysing a quantity of it.

"The foregoing analysis shows that this water is badly contaminated with organic matter—it is, in fact, quite putrid. I understand this water was drawn from the East London Company's supply pipes, in which dead fish have been occasicnally found; the organic contamination in this water is such as might be derived from this source. I need scarcely say that the putrid and offensive character of this water renders it absolutely unfit for use, and highly dangerous to health.

"The importance of this subject must be my apology for asking so much of your space.—I am, your obedient servant,

"Wm. HORN,
"*Chief Sanitary Inspector,*
"*West Ham Local Board.*"

"Stratford, *October 9th*, 1886.

Sir—I notice a paragraph under the above heading in your issue of to-day, and being the medical officer of health of the district referred to, I should be glad to say a word on the subject.

It is true that not only one but eight cases of illness occurred at a house in Warton Road, Stratford, lately, each of which I traced distinctly as having been caused by drinking water from a pipe leading direct from the East London Waterworks Company's mains. I examined this water and found it to be putrid and full of organic matter. I also sent a sample of it to Mr. Pooley, the Public Analyst, who in his report confirms what I say. I also saw in the chief sanitary inspector's office the eel that was afterwards taken from the pipe; it was quite putrid, and had evidently been about a foot long. Apparently it had died from want of room in the pipe. Your paragraph states that "samples of the water were taken on the spot and tested for organic matter without result." I should say this was probable after the rotten eel had been removed and the pipe blown out before their samples were taken. I entireiy disagree with the opinion of Dr. Tidy that a decomposed fish could not contaminate water sufficiently to cause typhoid fever; in this case seven of the persons suffering were seized with sickness and faintness soon after drinking the water, and this was followed by feverish symptoms and diarrhœa, which lasted several days. The only person in the house who escaped did not drink the water; the eighth person—a lad aged seventeen years, who drank most and longest of the water—first had the same symptoms as the others, but drifted into typhoid fever, and he now lies dangerously ill of the complaint. Cases of putrid water in dwelling-houses from this same cause are now constantly cropping up in this parish; and when I say that this has lately occurred in a Board School, where some hundreds of children drink the water, and also at a large public-house, I think I have said enough to show a very serious condition of matters.

Whether it is in the power of the waterworks company to remedy the evil I am not able to say; but should any death arise from this contaminated water, I shall endeavour to get their liability tested by a coroner's jury.

That the Government water examiner should have ignored the sanitary authority of this parish in making his inquiries in this matter, by whom the complaints have been made, and treated with the officials of the water company alone is beyond my comprehension.—I am, yours obediently,

THOS. DRAKE, *Medical Officer of Health for West Ham.*

STRATFORD, *October 9th*, 1886.

"Daily Chronicle," October 12th, 1886.

"Londoners have long been accustomed to "living organisms" of suspicious origin in the fluid supplied by some of the metropolitan water companies, but until the other day there was no reason to imagine that the mains of these companies were favourite haunts of the sportive eel. Ample evidence, however, has now been collected to prove that eels infest some of the water-mains in East London. If only living specimens of these edible fish were found there no great objection, perhaps, would be raised against their presence, but, unfortunately, the close atmosphere of the mains does not seem to agree with all the eels attracted thither; consequently many of them die, and thus contaminate the water with putridity. Both the sanitary inspector and the medical officer of health for the West Ham district have called the attention of the East London Waterworks Company to this alleged source of serious danger to health, but it is stated that the replies sent by the directors to the complaints made to them have not. so far, been at all satisfactory. This is surely a matter, however, which demands their immediate consideration, for several cases of illness have occurred, the origin of which the medical officer traces directly to the water polluted by the dead eels. The nuisance seems to be rather increasing than abating as the sanitary inspector states that the number of eels in the mains he has examined has augmented since he made his first complaint to the company. Dead fish are, it is stated, to be found in the water mains all over the extensive district from Bow Bridge to Silvertown, and from the Thames to Leyton. It is intolerable that the vast population inhabiting this great district should run the risk of being poisoned by drinking putrid water. With an efficient system of filtration the migration of eels into the water mains might be prevented and the danger which threatens large numbers of people in the East-end removed. This dead eel nuisance illustrates one of the chief evils arising from handing over so important a matter as the water supply to private enterprise. The supply should be under the control of the ratepayers, in which case a remedy for such an evil as that complained of in East London would doubtless be speedily found."

"Daily Telegraph," October 7th, 1886.

EELS IN WATER MAINS.

In consequence of the recent complaint of the Local Board of West Ham to the Local Government Board, Sir Francis Bolton, the examiner of water, has been investigating a case where, it was alleged, typhoid fever had been caused by the pollution of the water supply by reason of a dead eel having lodged in the pipe. It is a grievance of some years' standing, as may be seen from the report of the water examiner, who in 1884, in August, September, and October, reported to the following effect: "The East London Water Works Company have occasionally been troubled by eels during the past summer, and also every preceding summer since the Middlesex filters at Lea Bridge Works collapsed some three or four years ago. These old filters were then condemned by the water examiner and entirely reconstructed on new principles. The only effectual method would be to wash out, at one time, upwards of 780 miles of mains, varying in size from three inches to four feet in diameter, besides a great many miles of communication pipes; but this would be impossible, unless the consumers went without water for ten days, which they could not very well do, as upwards of 137,000 houses have a constant supply, and are therefore unprovided with large cisterns. Only eels about as thick as a knitting needle and an inch and a half long can get up the communication pipes into the houses, and thereby create a stoppage; but there are many much larger in the mains, where there is no current to speak of. They are said to be perfectly blind and quite white. How they can resist the pressure, varying from 30lb. to 100lb. to the square inch, naturalists must explain. A diver recently had the misfortune to break a valve and let the air escape, and the pressure of water, about 30lb. to the square inch, was sufficient to crush him to death. It has been suggested that strainers should be provided, but this would mean that dead eels would collect and become offensive, and there would be great difficulty in blownig them out. Some hope is entertained that when the company is able to charge its mains with well water from the chalk exclusively the eels will not be able to survive the change. How they subsist at present is a puzzle.

What has been said of and undeniably proved in respect of eels in the East London Water Company's reservoirs and house supply pipes, has been confirmed in the most indisputable manner by the following letter:—

STRANGE PHENOMENON.

"TO THE EDITOR OF THE DAILY CHRONICLE."

SIR,—This morning a strange and unpleasant visitor arrived through our water supply tap, which we have always used for drinking purposes, namely, an eel about 12 in. long, seemingly in excellent health, and in no way injured from its passage through the narrow pipes. But one rather shudders at the idea of a kettle being filled and water used without discovering its existence; or, on the other hand, the idea of one or two of these lively creatures dying in your "pipes," is not a pleasant thought to a water drinker. We shall be pleased to show this unwelcome visitor to anyone interested.

We remain, SIR, yours faithfully (Goy Limited).

H. F. GRIFFIN, *Managing Director.*

22, Leadenhall Street, E.C., *October 26th.*

The above letter refers to the New River Company's water, and published in the London daily papers of October 28th, 1886.

"Daily Chronicle," October 11th, 1886.

ON SMELLS.

The sense of smell is not the least sensitive of all the senses. It is so exquisitely fine, that the perfume of the violet or the rose awakens a gratefu response; while, on the contrary, a stench has a tendency to turn the stomach and make one sick. Unwholesome as well as disagreeable, bad odours poison the pure air of heaven and affect more or less all persons who inhale them.

We must never forget, however, that our civilization is still far from being perfect; that while we are justly proud of the advances that we have made, and are making, in education, and of the triumphs gained by Science, our pride and our boast should be qualified by the stubborn fact that ventilation and sanitation are still in an inchoate and unsatisfactory state. In these respects Science has not yet divulged the most precious of her secrets. Both ventilation and sanitation are of essential importance to the comfort and longevity of mankind, yet both are in this present day of enlightenment very crude and very defective. Let us hope that ere long these two blots and blemishes will be diminished, if not entirely effaced, from the escutcheons of nations. No stronger proof of the backwardness of sanitation in the United Kingdom could be given than that supplied by the town rivers of three of our largest centres of population. The Thames is bad enough, though that portion of it which runs through the heart of London has been greatly improved within the last decade. But there is still ample scope and verge enough for improvement, and we trust that the authorities will never rest until the Thames becomes, if not exactly "silvery," at least free from that deadly effluvium which is so pernicious and demoralizing to the dwellers upon its banks. The Clyde, too, is in a horrible state of foulness from Glasgow to Greenock. On a hot summers's day the stench is indescribably nauseous, causing an excursion on its fetid waters to be remembered as the superlative degree of unsavouriness! If the Town Council of Glasgow—a wealthy and flourishing city—wish to become famous, they should exert all their might to remove the reproach which they incur through the condition of their river. If they be not deaf to the calls of philanthropy and patriotism, they should forthwith take such steps as the necessities of the case urgently and imperatively demand. Surely in such a home of wealth and engineering skill, it is not impossible to remove a stigma so dangerous and disgraceful. Then again, the river Liffey, running through "dear and dirty Dublin," is simply an open sewer of the most repulsive description. When the tide is out the quays and the bridges of that sleepy capital are unbearable to the stranger —to all, indeed, but the "seasoned" denizens, whose natural sense of smell must long since have been contaminated by custom. We suppose that this hotbed of corruption and disease is under the immediate control of the Home Rule Corporation, which is composed of persons so "superior" as to deem sanitation quite unworthy of their notice. The "landlords" certainly have nothing to do with the Liffey; *they* are not accountable for its reeking abominations. Then who are, if the city magnates are not? The writer of this article a few summers ago, while crossing Carlisle Bridge on an outside car, was literally "struck" with the stench of the Liffey. "This is a horrible smell, carman; is it always like this?" "Oh! begor it isn't, sorr, I'm sorry to say! Why, sorr, its as sweet as a nut compared with what it is sometimes. Bedad, sorr, you might hang yer hat on the smell iv'ry day in July—its so strong then! aye, it makes the horses sneeze like a dose of Lundyfut's snuff. But we're used to it, sorr." Just so; the citizens are used to it, and so is the Corporation: and so the seething materials of a pestilence are always conveniently ready and at hand. Happily London and Glasgow are moving in the right direction as regards the condition of their rivers; but Dublin, which, like Falstaff, shows an alacrity for sinking, makes no sign.

"Daily Chronicle," October 12th, 1886.

ON SMELLS.

Sir,—This was the first article my eye rested upon in opening your paper this morning, and I may tell you every word was read with the greatest interest. But one need not go as far as Glasgow, or the Liffey, Dublin, to be poisoned with stench, Just take a 1s. 3d. ticket from London on the L.C.D.R. and alight at Swanley any day, and you will witness the carting of manure from early morning till night—a sight worthy of Hogarth! During the summer months and the late few days' hot weather the stench has been intolerable and I may say the residents are, literally speaking, living on the top of a dunghill composed chiefly of the worst of London filth, including a few defunct animals, which emits without cessation its deadly fumes, and poisons the surrounding air for miles. Our Local Board say they are powerless to interfere. The Local Government Board has been petitioned, apparently, without the slightest action being taken in the matter, other than the acknowledgment of same, although a letter from Dr. TUCKER, F.R.C.S., the deputy medical sanitary officer, accompanied the petition, denouncing the traffic as a disgrace to sanitation. Notwithstanding all efforts on the part of the residents, with railway company and otherwise, to alter the dreadful state of affairs, the manure still comes down, not by tons, but thousands, and a whole line of trucks is the usual daily deposit of the several goods trains. The goods-yard is saturated inches deep with mire and filth, and often has been seen a mixed consignment, ranging from edible provisions to a traction engine, huddled together in the midst of tons of this vile stuff. If something is not soon done to put down the existing nuisance, the health and prospects of this rising neighbourhood will be ruined.

SWANLEY JUNCTION, *October 11th*, 1886. SUFFERER.

WATER COMPANIES AND THE PUBLIC.

Mr. PICKERSGILL asked the President of the Local Government Board* whether his attention had been drawn to the report for the past year of Mr. F. M. Corner, medical officer to the Poplar Board of Works, in which the following passage occurs :—" A greater scandal cannot well be shown in matters vital to health than that, in spite of abundant evidence of the magnitude of the evil, thousands and tens of thousands of families living in houses the rates of which are payable by the landlords may at any moment, without a particle of fault of their own, be suddenly denied one of the first necessaries of life, water, through the neglect or wilfulness of others. That disease and death are directly traceable to this want no one acquainted with sanitary work in London can doubt. Take this instance: Water cut off, drains stopped, opening up of ground and drains, removal of filth accumulation, horrid stench, diphtheria, death. Should the tenant justly refuse to pay the rent, the water supply being included in the charge, the law allows of the broker being put in, as was done in Cotton Street in 1885, when the goods of a widow were seized until the whole was paid, although the house had been without water for six weeks. In Hanbury Place, having six houses, there was no water supply for 26 days, and families numbering each seven, nine, two or six, and others had to exist, in May 1885, with choked drains, yard flooded with sewage, and no water, and all because of non-payment of rates by their landlord. In another case there was no water for 17 days. In a third, from Nos. 2 to 10, Galbraith Street, with a population of 74, there was no water supply from the same cause for 14 days."† And whether, in the paramount interest of the health of the people, the Local Government Board will, pending legislation, make representations to the water companies, or take such other steps as may be necessary, with a view to prevent the recurrence of the condition of things here described.

Mr. RITCHIE said the condition of things as shown by the extract brought by the hon. gentleman under the attention of the House was undoubtedly one that urgently called for a remedy. The hon. member was aware that last year a bill passed through the House of Lords and got into committee in the House of Commons, which would have prevented the cutting off of water under all circumstances, and in his opinion it was urgently necessary that the law should be amended in such a way as to prevent the cutting off of water from tenements He would be glad to convey the question and the extract from the report of the medical officer to the various water companies in London. The hon. member was aware that he had no power whatever over these companies; but he earnestly hoped that the water companies would take care that the powers which they possessed by law were not exercised in such a manner as would be detrimental to the community and extremely hard upon the tenants.

---

* House of Commons, 1886.

† In Dr. M. Corner's annual report, 1884-5, as Medical Officer of Health of Mile End Old Town, 48 houses had been provided with water supply! Evidence that other dwellings are still without a proper water supply.

Water for Animals.

What a common practice in every country exists to give water regardless of its impurity, and other conditions, to our domestic animals, those of the stables and of the farm yard.

In towns, public troughs offer water to the thirsty animal. In the farm yard the trough, or pond is filled chiefly with rain water. The stables may be supplied from the main, or from a well,

In every case the undoubtedly impure water, as also the mineral constituents, must injuriously affect the condition of the animal. Rabies may be caused by unwholesome water, as in respect of every other suffering of the animal world. Any animal, imbibing the visible and invisible living organisms in water, must be subject to the like results as when imbibed by the human being.*

The susceptability of all living as well as dead animals to engender microbes, tapeworms, and other flesh producing corruption, is recognised by medical authority as a sure way of communicating, particularly the cat and dog, by reason of their domestic habits and close contiguity to the house water, the ova to the human being.

When we reflect on the terrible consequences of animal skin disease—*i.e.*, the mange, one of the most disgusting—*so infectious* amongst animals, transmitted through the water of the village pond, the stream, the river, and the open filter beds, into the homes of every class, for the preparation of the daily meals, and for the purposes of ablution, and laundry, into which the "glandered" horse and the "manged" dog are taken, regardless of other running sores.

---

* Geo. B. Mead, Esq., M.D., L.R.C.P., London, attests to the improved condition of Captain Machell's training establishment at Newmarket, by the treatment of the Water Supply by the "Atkins" System, and the absence of disease in the horses, previously so frequent.

PART III.

Conclusion.

Although it was, doubtless, well known to our forefathers that "carbonates" could be removed from hard water by the use of lime, for in 1814, in the description of a brine spring discovered about thirty years previously, at Birtley colliery, a foot note is as follows :—"The carbonates, small as is their proportion, are sufficient to make the water turbid . . . These are very readily thrown down by the addition of quick lime . . . ." it will thus be seen that the bare assertion of "quick lime" without any formula, or statement of proportions to bring about the admixture by gauge or measurement, left to Professor Clark the entire labour of establishing the principles upon which the process of softening water of any number of degrees of temporary hardness was to be carried out, in conformity with his recognised laws, and accepted by those who are ever engaged in the expansion of all knowledge of the science of chemistry in the interest of the community. So that for a period of twenty-seven years (from March, 1814, to March, 1841, when, at the latter date, Professor Clark was granted Her Majesty's Letters Patent) the subject of softened water had received no further solution.

In treating the subject in his laboratory, Professor Clark had accomplished all that the science of chemistry could possibly achieve, and he left to a sister science—that of engineering—the work of its practical adoption. Since the year 1841, many attempts have been made to utilize this great and important work of the talented Professor, than whom none are more deserving of the Nation's gratitude, for the benefit Professor Clark has for all times bestowed on the people in connection with the first of all requirements—soft water, so essential to a perfect condition of hygiene and sanitation for the man, the woman, the infant, the poor, the wealthy, and the animal, nature not allowing any distinction between the creature in poverty, and the one enveloped in robes of Royalty, or Imperialism; in the simple fare of the daily toiler, and the exquisite delicacies of the rich man's table. The source of disease for the one is the medium for the other. Privilege and immunity being unknown in the laws of nature, in which no alteration has taken place from the beginning of all time, or will take place to the end of all time. The only change possible is that of society—capricious, whimsical, frivolous, by reason of the increase of one community to the decrease of another. So with the supply of water, the natural sources are no longer sufficient, and artificial means have to be provided for the demand, hence it is that the water in its natural purity and softness is no longer obtainable, and in the interest of the common health it must undergo previous treatment for the certain removal of all poisonous and deleterious matters it unavoidably contains.

Water companies, in the early stage of the completion of Professor Clark's complicated labours, made efforts to adapt his process to their existing reservoirs; but those efforts were speedily abandoned, owing to the vast area of land, in addition to the actual filter beds that would be required.

Partially the process is in operation in one or two cases, with a practical and a financial result anything but satisfactory, both to the water consumers and the shareholders, as had been intended by Professor Clark to economise the resources of water enterprise.

Notwithstanding the very urgent recommendations made by the Royal Commissioners in their respective reports, from 1866 to 1874, and of the Lords' Committees of 1840 and 1873, also the conclusions of the Select Committees of the House of Commons, of 1821, 1828 and 1834, "Presented to both Houses of Parliament by command of Her Majesty," as to the necessity of a better quality of water for the entire community, both as regards supply for all industries, and for domestic purposes, hygiene and sanitation guiding them in those recommendations and conclusions, the Professor's important process remains unnoticed in this year of grace, 1887, throughout the United Kingdom of Great Britain and Ireland, with a few exceptions, comprising very restricted areas and limited numbers of the community.

It is solely on the sister science of engineering that the future supply of pure and soft water depends, and to which the whole of the British people have daily a most righteous claim.

The first duty of the Government, irrespective of political views, is to make at once such arrangements that Professor Clark's process may be adopted throughout the length and breadth of the British Isles, and the extensive dominions of the Crown. Expense and doubtful results have ostensibly led to the delay in the adoption of Professor Clark's process, to which may be added the exclusion of Government interference with the action of water companies, and water corporations under their respective Acts of Parliament, by which their monopoly is secured.

I have now reached the question of settlement between the water companies on the one hand, and on the other hand the consumers, through the representatives of the constituencies in Parliament.

The question resolves itself into one of value as to water companies, and into a second as to the the price to be paid by Parliament for the undertakings carried on by private and public companies. The basis of the terms is a matter of recognised commercial principle.

Taking the purchase of water supply to be concluded, there remains only the method by which Professor Clark's process can be most economically, and at the same time, most effectually carried out. This important feature, second only to the Professor's great work, stands out more prominently as a question of daily expense in the supply of pure and soft water, inasmuch as the charge for pure and soft water could be proportionably reduced in comparison with the present charges.

Having been for more than thirty years closely connected with the subject matter, "Water Supply," I have had every facility for obtaining a most complete knowledge of the various methods of treating "Water," and that under Messrs. Atkins's patents, for their system*, now the property of the "Atkins" Filter and Engineering Company, Limited, 33, Bouverie Street, London, E.C., most effectually carries out Professor Clark's process, as to be unsurpassed by mechanical precision in the treatment so essential in the application of the able Professor's profound chemical researches, owing to the *absolute necessity of regulating the quantities with the ascertained degrees of hardness of the water.*

Thus, after a lapse of forty-six years, the benefits of Professor Clark's invaluable discovery to provide soft and pure water that will not endanger life, but will give great hygienic and sanitary results, can now be assured to every community on an unlimited scale as to quantity.

---

* The Local Government Board has sanctioned in numerous cases of local water supply the adoption of the "Atkin's" system—Wellingborough, Southampton, Henley-on-Thames, wholly supplied thereby, are amongst those places authorised to raise loans for the purpose.

APPENDIX.

Sir Robert Rawlinson, C.E., C.B., has kindly furnished the author with the following:—Professor Clark proved that two waters of different degrees of hardness when mixed would not give a medium hardness, but on the contrary a hardness that would exceed the higher of the two.

In the address delivered by Sir Robert Rawlinson, as President of the Sanitary Congress of Great Britain, at Dublin, 1884, "improved water supply" is strongly urged.

Sir Robert Rawlinson also asserts that for London the supply of water being about 160 to 170 million gallons per day, 160 to 170 tons of lime are consumed daily in the Metropolis, being one ton of lime in every million gallons.

NOTE.—The Softening of the Water Supply at Sandringham was carried out by Sir ROBERT RAWLINSON for H.R.H. THE PRINCE OF WALES, by the CLARK Process.

In "London Water Supply," by F. J. Bramwell,* Esq., C.E., and E. Easton, Esq., C.E., read at the British Association, at Plymouth, 1877, is the following:—"Nor do we believe that they (the public) ever will be satisfied, or can be satisfied, so long as that water is derived from rivers into which is poured the sewage of a great part of the large population of the basins of the Thames and of the Lea, and also the surface drainage from the highly cultivated, and, therefore, highly manured, land of those basins."

---

* Now Sir FREDERICK BRAMWELL.

Earl Fortescue, the President, reminded the Association "that in the County of Devon the propriety of reserving a high quality of water for drinking purposes, was so well understood, that the farmers and cottagers distinguished between best water and water of an inferior character, and gave them the names of 'Potwater' and 'Slopwater.'"

Dr. Farr said "it was clear that satisfactory water could never be got from the River Thames· He, however, would recommend, even on culinary grounds, that the water should be softened by Clark's process."

As President of Section at the British Association, Dublin, 1878, a valuable address was delivered by E. Easton, Esq., C.E., on "the Conservancy of Rivers and Streams, in the widest sense of the term." The address embraced the Water Works of Greece, Rome, Egypt, Asia, &c., of the earliest periods.

In "Water Supply," by Edward Easton, Esq., M. Inst. C.E., read at the International Health Exhibition, London, 1884, states:—"It is now generally admitted that a soft water is preferable to a hard water, provided that the storage and distribution are properly carried out, and in every case where there is a choice of supplies, that which is soft, or which can be softened by simple means, should be chosen."

The process invented by Professor Clark for softening hard water by the deposition of a portion of the lime, is of a very simple character.

Mr. E. Easton, C.E., at a meeting of the most eminent authorities on "Water Supply," at Brighton Water Works in 1884, said with reference to the question of "Softening" the water of the Town:— . . . . "this was the only other point of improvement which could possibly be adopted to make the water supply what he called perfect."

Mr. W. Whitaker, of the Geological Survey of England, said:—"Referring to the softening processes, great improvement was being made, and as improvement meant also cheapness, most likely in a few years they would be able to soften water much cheaper and much better than it could be now." *

WELLCOME LIBRARY INSTITUTE

---

* That time has been reached, see page 91.